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UNIVERSITY OF ALBERTA

THE ROLE OF STRESS INOCULATION TRAINING AND SKILLS ACQUISITION IN INCREASING ATHLETIC PAIN TOLERANCE

BY

BLAIR GARNET WHITMARSH

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

DEPARTMENT OF PHYSICAL EDUCATION AND SPORT STUDIES

EDMONTON, ALBERTA

SPRING, 1992

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ISBN 0-315-73074-9

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DEGREE: Master of Arts

YEAR THIS DEGREE GRANTED: Spring, 1992

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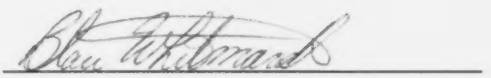

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DEDICATION

This work is dedicated to my wife Lorraine and my daughter Karina who have supported and lovingly encouraged me through the ups and downs of graduate life. They are a breath of fresh air and I love them both very much.

ABSTRACT

Endurance athletes across all sports have indicated that the ability to tolerate high levels of athletic pain or discomfort accounted for much of their success (Egan, 1987). This study examined the role of Stress Inoculation Training (Meichenbaum, 1985) and one of it's components, Skills Acquisition, in increasing tolerance of discomfort on an isometric quadriceps task. Stress Inoculation Training is a comprehensive treatment paradigm made up from a variety of stress management techniques and consisting of three different phases: Conceptualization, Skills Acquisition, and Application. Forty-five endurance athletes from three different sports; rowing, cycling and triathlon, completed the study which consisted of performing a wall sit for as long as possible in a pretreatment-posttreatment control group design. Along with performing the wall sit, subjects reported their perceived discomfort levels every 20 seconds throughout the entire wall sit. The results indicated that subjects receiving training in Stress Inoculation Training or Skills Acquisition significantly increased their tolerance time on the wall sit ($F = 2.51$, $P < .047$) as compared to the control. However, consistent with other research (Vallis, 1984) there was no significant difference between subjects who received training in Stress Inoculation Training and those who received training in the Skills Acquisition component only. Secondly, a relationship was found between experimental subjects perceived discomfort levels and the length of time they tolerated the wall sit indicating that psychological training may assist athletes

in perceiving physical discomfort more realistically. The results of this study suggest that training in Stress Inoculation Training or Skills Acquisition may assist athletes in tolerating higher levels of physical discomfort during training and competition.

ACKNOWLEDGMENTS

I would like to thank Dr. Richard Alderman for his willingness to share his practical knowledge and experience in Sport Psychology. I would also like to thank the other members of my committee, Dr. Brian Nielsen, Dr. Garry Smith and Dr. Dave Sande for their helpful comments in the development and completion of this project.

Special thanks go to my parents, Garnet and June Whitmarsh. They had the difficult challenge of raising me and have been a continual source of encouragement, love, and support. I am deeply grateful that they are my parents.

Two fellow graduate students, Daryl Marchant and Kerry Mummery, for their much appreciated counsel and source of motivation.

Murray Hall of Trinity Western University for his dedicated example of professionalism and his encouragement to pursue graduate work.

Finally, the subjects who so willingly participated in this project.

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CHAPTER 1

INTRODUCTION

Throughout life people are confronted with many situations in which the ability to tolerate pain is extremely important. Individuals undergoing major surgery, or those suffering from a terminal illness, must cope with severe pain on a daily basis. Women in labor must also cope with intense pain. Increased pain tolerance is, in fact, beneficial in most medical and dental procedures. The characteristics of high pain tolerance, however, are beneficial not only to the medical field, but are also desirable in the area of athletics. The athlete who has a high level of pain tolerance is, in most situations, expected to achieve a higher level of performance than the athlete with a low level of pain tolerance.

Successful athletes in boxing, football and hockey are paid millions of dollars each year to perform and in such sports, the toleration of high levels of pain is often a part of the price of success. A Swedish NHL player stated that "hockey demands pain tolerance because hurting is part of the game" and he considered the ability to tolerate pain as the most important quality of a successful hockey player (Heinila, [cited in Egan, 1987]). Bill Koch, silver medalist at the 1976 Olympics in the 30 km cross country skiing race, felt that 90 percent of his success could be attributed to his ability to tolerate pain (Iso-Ahola and Hatfield, 1986) and Greg LeMond, three time winner of the Tour de France (considered by many to be the

most gruelling race in sport) is quoted as saying, "... the best climbers are those ones who can stand the most pain ... in pro cycling everything hurts, but you just ride through it (Avins, [cited in Egan, 1977])."

Different types of pain may be associated with different sports. The pain experienced in boxing is different from that experienced in hockey, which differs yet again from that experienced in endurance sports. Boxing pain may be characterized as intense pain lasting a relatively short period, of time while the pain experienced in endurance sports may be characterized as extreme discomfort, lasting for a long period of time. Furthermore, all athletes are not equal in their ability to tolerate pain. Pain tolerance is probably a learned skill, and may be the most important psychological skill an athlete can develop. It is surprising that sport researchers and coaches do not make an effort to develop this ability to its full potential.

The distinction must be made between the athlete experiencing pain and the athlete experiencing physical discomfort. Pain is a basic sensation that may be caused by harmful stimuli or may be an indication of physiological damage, whereas physical discomfort is a natural part of the athletic experience and is not physically harmful to the athlete. A second distinction must be made between the athlete who experiences pain as a result of injury and the healthy athlete who experiences physical discomfort. An athlete who is injured should be involved in rest and rehabilitation or risk the chance of further injury. However, the healthy athlete who experiences physical discomfort will desire to increase his or her

tolerance of that discomfort. Therefore, sport researchers and coaches should take an active role in providing training and instruction of discomfort control strategies for athletes.

In 1965, Melzack and Wall developed the gate-control theory of pain. This theory was the first to acknowledge the psychological component of pain, and to expand psychological pain therapy. The gate-control theory of pain is a biologically based theory, but acknowledges the role of three psychological dimensions: sensory-discriminative, motivational-affective, and cognitive-evaluative. The sensory-discriminative dimension involves information concerning the location and intensity of the stimulation. The motivational-affective dimension carries information about the aversive aspects of the stimulation and finally, the cognitive-evaluative dimension involves making a mental evaluation of the pain stimulation (Beach, 1981).

Since the development of this gate-control theory, researchers have been interested in developing psychological strategies to deal with psychological stress and pain. One of the most promising programs is Stress Inoculation Training (SIT). It was originally developed by Donald Meichenbaum and Roy Cameron in 1973 while at the University of Waterloo. SIT is not a single technique, but is a treatment paradigm made up from a variety of stress management techniques.

The following study will examine the effectiveness of stress inoculation training and one of its phases, skills acquisition, in increasing athletic tolerance of physical discomfort.

Rationale for the Study

The study is justified for both practical and theoretical reasons. From a practical perspective, the ability to tolerate high levels of physical discomfort is important for athletic success. However, coaches and athletes rarely spend time developing this ability to its full potential. Because coaches and athletes have little spare time, a program that is effective, relevant and easy to administer is necessary to develop this ability. Since SIT has demonstrated its effectiveness in dealing with pain in a clinical or medical setting, a sport-related SIT may be effective in dealing with athletic discomfort. This study will examine the effectiveness of a sport-related Stress Inoculation Training (SIT) program and a Skills Acquisition only (SA) program conducted over a relatively short period of time.

From a theoretical perspective, pain tolerance research in the sport setting has been limited. The majority of existing research deals with the comparison of different types of athletes and pain tolerance (Ryan and Kovacic, 1966; Egan, 1987) and pain tolerance for the athletes with injury (Masters and Lambert, 1989). Morgan (1978, 1980) has done extensive work in pain tolerance with injury free marathon runners and others have done research based on Morgan's work in the associative and dissociative styles of attention-distraction. With the exception of these few studies, increasing pain tolerance of the injury free athlete to improve performance has been virtually non-existent as a topic of research.

Delimitations

The scope of this study will be delimited as follows:

1. The subject sample will be delimited to forty-five athletes from three "leg-dominated" endurance sports: rowing, cycling and triathlon.
2. All subjects were observed and tested by one examiner on an individual basis throughout the study.
3. All training sessions were administered by one instructor throughout the study.
4. Data was collected on three separate occasions using the exact same procedure and location on each occasion.

Limitations

1. The self-report and open-ended qualitative questionnaire results were dependent on subjects' honesty during and after the tasks.
2. Due to the subject familiarity with each other prior to the start of the study, treatment effectiveness was dependent on subjects' cooperation not to disclose information concerning their part in the study.
3. Subject testing took place on three different occasions; differences in subject motivation levels or physical fatigue were not controlled for.

Operational Definitions

Application and Follow-Through - refers to the third and final phase of stress inoculation training in which clients are given opportunity to practice the

knowledge and skills they acquired during the first two phases of the training.

Attention Diversion - refers to a mode of thinking in which the individual concentrates on something else in order to alleviate a stressful or painful situation. This may be done by concentrating on physiological and\or technical demands during an activity (internal) or by intentionally focussing ones' thoughts on something completely different than the activity currently engaged (external).

Conceptualization - refers to the first phase of stress inoculation training in which clients receive education from a theoretical perspective about their problem situation.

Gate-Control Theory - the first biological theory of pain that acknowledged that pain was influenced by psychological processes. Developed in 1967 by Melzack and Wall.

In Vitro - practicing newly acquired psychological skills through the use of imaginal situations.

In Vivo - practicing newly acquired psychological skills through the use of real-life situations.

Pain - refers to an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. (IASP, [cited in Weisenberg, 1987])

Pain Threshold - refers to the level of stimulus at which the subject first recognizes pain or discomfort. This is more dependent on physiological factors (Merskey

and Spear, 1967 [cited in Woodrow et al, 1972]).

Pain Tolerance - refers to the level of stimulus at which the subject can no longer handle the pain and must attempt to decrease the severity of the stimulus. This is more dependent on psychological factors (Merskey and Spear, 1967 [cited in Woodrow et al, 1972]).

Physical Discomfort - an uncomfortable, but natural part of the athletic experience which is not physically harmful to the athlete. An example of this would be the discomfort experienced by a runner near the end of a 26 mile marathon.

Skills Acquisition - the middle phase of stress inoculation training which provides clients with psychological skills to assist them in handling their problem situation.

Stress Inoculation Training - a treatment paradigm made up from a variety of stress management techniques to help clients deal with psychological stress and pain. The SIT paradigm consists of three phases: conceptualization, skills acquisition and rehearsal, and application and follow-through.

Statement of the Problem

The central purpose of this study was to investigate the effectiveness of stress inoculation training and one of its phases, skills acquisition, in increasing tolerance of physical discomfort in competitive athletes.

This research should evaluate the efficacy of a sport-related SIT program and provide evidence that a cognitive-behavioral treatment program can indeed increase

tolerance of physical discomfort on a muscular endurance task.

The subsidiary purposes of this research will be:

1. To examine the effectiveness of SIT on subjective pain ratings.
2. To examine the effectiveness of an SIT program of a short duration.
3. To examine the effectiveness of a sport-related SIT program on acute pain tolerance of a muscular endurance task.
4. To examine the durability of SIT under controlled conditions.

Major Questions.

The major question in this study is whether or not the physical discomfort athletes experience in their sport can be managed more effectively as a result of psychological skill training. Specifically, the questions were:

1. Is SIT an effective means of increasing tolerance of physical discomfort from pretreatment to follow-up under controlled conditions?
2. Is SIT more effective than single strategy procedures (SA) for increasing tolerance of physical discomfort from pretreatment to follow-up under controlled conditions?

Hypotheses

Based on the review of literature, the following hypotheses were generated for the study.

Hypothesis 1

1. **The SA treatment group and the SIT treatment group will have significantly higher changes in tolerance of physical discomfort compared to the control group from pretreatment to posttreatment.**

Hypothesis 2

2. **The SIT treatment group will have significantly higher changes in tolerance of physical discomfort compared to the SA treatment group from pretreatment to posttreatment.**

Hypothesis 3

3. **The SA treatment group and the SIT treatment group will have significantly lower subjective discomfort ratings from pretreatment to posttreatment.**

Hypothesis 4

4. **The control group will not have significantly lower subjective discomfort ratings from pretreatment to posttreatment.**

CHAPTER 2

REVIEW OF LITERATURE

The review of literature is divided into three main areas: physiological and psychological theories of pain, conceptual approaches to pain management, and a review of stress inoculation training.

Theories of Pain

Specificity Theory

The specificity theory is the traditional theory of pain. It has been taught for centuries in the medical realm and was often presented as proven fact rather than "theory". The best classical description of the theory was proposed by Descartes in 1664. He posited that the pain system was a straight line path from the skin to the brain and suggested that a hot flame on the skin of the foot would set particles from the foot into activity. These particles would then travel up the leg and finally reach the brain. At the brain an alarm system would be set off, pain would be felt, and the person would then react to the pain (Melzack and Wall, 1983).

In 1842, Muller developed his doctrine of specific nerve energies believing that the brain received information about the external world through the sensory nerves. Activity in the nerves was seen to represent symbolic data concerning the stimulus.

It was already known that nerve impulses are essentially the same in all sensory nerves. Muller proposed, however, that the quality of the sensation was related to the termination of the nerves in the brain. Therefore, Muller's concept was a straight- through system of sensory nerves to the brain, but each sensory nerve was seen to have a different terminal center in the brain.

Influenced by Muller's work, Max Von Grey laid down the groundwork for the modern theory of specificity. Von Grey expanded Muller's concept to include four cutaneous modalities: touch, warmth, cold and pain, each with its own pathway and termination center in the brain. As well as using the work of Muller, Von Grey incorporated information from earlier studies of the fine structure of body tissues. He reasoned that, since free nerve endings were so common in the skin and pain spots are found almost everywhere, then free nerve endings must be pain receptors (Melzack and Wall, 1983).

The designation of free nerve endings as pain receptors is the basis for the specificity theory. It provides a simple solution to pain: specific pain receptors in tissue project via pain fibres and a pain pathway to the pain centers in the brain. The assumptions found within specificity theory fall under the three disciplines of physiology, anatomy and psychology. The physiological assumption that receptors are specialized has been proven to be true. However, the anatomical assumption that a specific receptor lies beneath each sensory spot on the skin and the psychological assumption that each psychological dimension bears a one-to-one relation to a given type of skin receptor have both been proven false (Melzack and

Wall, 1983).

Pattern Theory

In reaction to the flaws found within specificity theory, various other theories have been developed that can be grouped under the general heading of pattern theory. Pattern theory proposes that stimulus intensity and central summation are the critical determinants of pain. Particular patterns of nerve impulses are produced by summation of the skin sensory input at the dorsal horn cells. Pain results when excessive stimulation of receptors or pathological conditions cause the total output of cells to exceed a critical level (Melzack and Wall, [cited in Weisenberg, 1975]).

Two of the more common pattern theories are the central summation theory and the sensory interaction theory. The central summation theory, proposes that large fibres carry the touch sensation to the brain in a direct path. The small fibres carry the pain sensation in paths converging at the dorsal horn cell. The fibres then summate their input and transmit the pattern to the brain as pain. In sensory interaction theory, the large fibres inhibit central transmission of pain and the small fibres excite central transmission of pain. A shift in the ratio of large to small fibres favoring small fibres would therefore increase pain sensation. In contrast to the central summation theory, sensory interaction theory proposes that pain is transmitted through a multisynaptic afferent system in the spinal cord rather than a straight path to the brain (Melzack and Wall, 1983).

Gate-Control Theory

In 1965, Melzack and Wall proposed the gate-control theory of pain (see Appendix C) in an attempt to bring together the strengths from past theories into a comprehensive theory of pain. Melzack and Wall believed that for any new theory of pain to be acceptable it must account for:

1. The high degree of physiological specialization of receptor-fibre units and of pathways in the central nervous system.
2. The role of temporal and spatial patterning in the transmission of information in the nervous system.
3. The influence of psychological processes on pain perception and response.
4. The clinical phenomena of spatial and temporal summation, spread of pain, and persistence of pain after healing.

(Melzack and Wall, 1983, p. 222)

Melzack and Wall's theory proposes that a neural mechanism in the dorsal horns of the spinal cord acts like a gate which controls the flow of nerve impulses from peripheral fibres to the central nervous system. The degree to which the flow of nerve impulses increases or decreases is regulated by the large and small fibres and by influences from the brain. When the amount of information passing through the gates exceeds the critical level, it activates two different neural areas responsible for pain experience.

The two neural areas or systems are called the sensory-discriminative system and the motivational-affective system. The sensory-discriminative system carries information concerning the location and intensity of the stimulation. The motivational-affective system carries information about the aversive qualities of the stimulation or suffering. Both of these systems are initiated simultaneously but processed separately. The systems then correspond to the central control process and interact to provide pain information to the brain. The central control process can either open or close the gate by activating the large fibres. Thus, modification of cognitive processes such as adaptive expectations or attentional focus could function to close the gate and reduce pain (Beach, 1981).

The interest of the gate-control theory for the field of psychology is that the theory contains an element of cognitive control. It proposes that anxiety, attention and past experience can have an effect on the pain process. It seems that some central activities such as excitement or anxiety may open or close the gates to all bodily inputs. It is suggested that maladaptive signals from the body must be identified and inhibited before the mechanism responsible for pain perception is activated (Melzack and Wall, 1983).

The gate control theory is extremely significant in that it promotes psychological pain research. It is the first theory to successfully demonstrate a link between the physiological and psychological influences of pain perception. It is relevant to psychological pain study because it recognizes that modifying pain through a variety of cognitive interventions is possible (Beach, 1981).

Theoretical and Therapeutical Methods of Pain Management.

Cognitive Methods

The term "cognitive" implies a technique in which pain is influenced through thought and belief. This stands in contrast to behavioral technique which modifies pain through behavior modification or physical intervention. The central assumption of the cognitive approach is that an individual's expectations, ideas, and "cognitions" of his or her environment can influence what he or she will see and feel. Faulty cognitions can lead to anxiety, increased sympathetic nervous system activity and, ultimately, worry, stress and pain. Cognitive methods for pain control therefore include such techniques as providing information about an upcoming event and teaching individuals to use cognitive coping skills such as distraction, imagery and calming self-statements (Tan, 1982).

According to Tan (1982), the provision of preparatory information has long been used as a means of controlling pain. This technique is aimed at changing an individual's distorted view of an event into a view that is more realistic. For example, many individuals experience a high degree of anxiety at the prospect of visiting the dentist because many individuals hold a distorted view of the dental procedure. The provision of preparatory information in this instance would present the dental procedure in a realistic manner and thereby reduce the anxiety. Preparatory information can be divided into two types. First, preparatory information may consist of procedural information about the objective aspects of

an upcoming event. Second, preparatory information may consist of sensory information about the specific sensations an individual is likely to experience during such an event.

Beach (1981) proposes that coping skills can be divided into two main categories: those which are aimed at enabling the individual to block out the pain, and those which require acknowledgement or confrontation of the stimulation.

Those techniques which encourage the blocking out of stimulation include analgesia instructions and attention-diversion. With analgesia instructions, clients are asked to imagine situations that are incompatible with the painful experience. This might include such pleasant events as sitting on the beach or re-identifying the pain as a sensation of numbness (Spanos, Horton, and Chaves, 1975 [cited in Beach, 1981]). Attention-diversion techniques are used to focus attention on something besides the pain. Attention-diversion can be executed internally by such methods as mental arithmetic or the making of lists, or it can be executed externally with activities such as focussing on clouds, a painted picture, and bird watching.

In 1982, Tan completed a review of cognitive control techniques and classified them as follows:

1. Imaginative Inattention

   Pain is ignored through the evocation of images that are incompatible with the pain experience. For example, going to the beach.

2. Imaginative Transformation of Pain

Noxious sensations are acknowledge but they are interpreted as trivial or unreal.

3. Imaginative Transformation of Context

Noxious sensations are acknowledged but the setting or contest is transformed. For example, one may picture oneself as "James Bond" having been shot in the leg.

4. Attention-Diversion (external)

Attention is focussed on the physical characteristics of the environment. For example, one may look at clouds or count telephone poles.

5. Attention-Diversion (internal)

Attention is focussed on self-generated thoughts. For example, one may perform mental arithmetic or list one's favorite songs.

6. Somatization

Attention is focussed on the part of the body receiving the intense stimulation but in a detached manner. For example, one may analyze the intense stimulation and sensations as if one were to write a biology report.

There has been considerable evidence that strategies aimed at blocking out aversive sensations are effective in increasing pain tolerance. After an intensive review of the literature, Fernandez and Turk (1989) found that overall efficacy of the cognitive strategies was found in 85% of the investigations. The investigations

demonstrated that cognitive strategies have a positive effect in enhancing pain tolerance in comparison to no-treatment. In their review, Fernandez and Turk (1989) found that each of the individual classes of strategies attenuated pain significantly, however, the imagery strategies tended to be most effective, while strategies involving repetitive cognitions or acknowledgement of pain sensations were among the least effective.

The second category of cognitive methods as proposed by Beach (1981) is comprised of methods that acknowledge and confront stimulation. The most common skill of this type is positive self-statements or self-talk. Since self-statements can be maladaptive and place a person into depression, it is hypothesized that positive self-statements could be uplifting, encouraging and adaptive. Meichenbaum (1976)(cited in Beach, 1981) identified three mechanisms by which changing internal dialogue operates: first, self-statements play a direct regulatory role, second, self-statements influence attentional focus, and third, self-statements influence the individuals interpretation of their physical state. Turk, Meichenbaum and Genest (1983) attributed the anxiety-reducing effects of self-statements to the reinterpretation of the pain sensations. Brucato (1978)(cited in Beach, 1981), on the other hand, reported findings which suggest that the attentional variables are more influential. Regardless of why positive self-statements work, there is convincing evidence that they do play an active role in pain reduction.

Cognitive-Behavioral Methods

Cognitive-behavioral methods for pain control are more comprehensive than cognitive methods alone. Cognitive-behavioral methods not only include cognitive interventions but also some behavioral components such as relaxation, biofeedback, desensitization, modeling, and assertion training. Turk, Meichenbaum and Genest (1983) state that cognitive-behavioral techniques are implemented in diverse ways such as rational-emotive therapies, cognitive therapy, coping skills therapies, problem-solving therapies, self-instructional training, self-control approaches or a combination of techniques such as the various multifaceted cognitive-behavioral treatment regimens. Even though there is a wide variety of therapeutic techniques based on cognitive-behavior modification there are some common elements that can be identified between the various techniques. Interventions are usually active, time-limited, and fairly structured with the underlying assumption that affect and behavior are largely determined by the way in which individuals construe the world. Therapy is designed to help the patient identify, reality-test, and correct distorted conceptualizations and dysfunctional beliefs. The common denominators of cognitive-behavioral approaches appear to be (1) interest in the nature and modification of patients' cognitions and feelings, as well as behaviors, and (2) some commitment to the use of behavior therapy procedures in promoting change (Turk, Meichenbaum, and Genest, 1983).

Two different multifaceted cognitive-behavioral treatment regimens: prepared childbirth and cognitive-affective stress management training, will be reviewed.

Prepared Childbirth

Labor pain may be said to be one of the most severe forms of pain and accordingly, several procedures have been developed to teach pregnant women how to cope with pain in childbirth. The most recently developed and most popular program today is "Lamaze" training, developed by Fernand Lamaze in 1970. The Lamaze method consists of 7 cognitive or behavioral components: structured breathing, relaxation, attention focal points, effluerage (ie., gentle self-massage), assistance of a coach, rehearsal under stress, and systematic practice (cited in Tan, 1982). Other training regimens have been developed to assist women during childbirth. All of them, however, are based on the Lamaze method and include, (1) the provision of detailed information on pregnancy and labor to the mother-to-be, (2) relaxation training to help the women to relax when uterine contractions increase in duration and intensity, (3) coping strategies to distract attention from pain, and (4) breathing exercises which are useful in distracting attention as well as relaxation (Melzack and Wall, 1983).

Two studies have supported the pain control efficacy of the Lamaze method. In 1980, Worthington and Martin found that both the structured breathing and the attention focussing of the Lamaze method were very effective in increasing pain tolerance (cited in Tan, 1982). In another study, Leventhal, Leventhal, Schacham, and Easterling (1989) found that pain, tiredness, and fear reached high levels as labor progressed while positive moods and sense of energy declined. However, those women using the Lamaze method reported having more energy and feeling

less pain than women not using the Lamaze method. It seems as if Lamaze classes may play a role in forming accurate expectations and thereby enhancing energy and positive mood.

Cognitive-affective Stress Management Training

Cognitive-affective stress management training (SMT) is a framework for stress management developed by Ronald E. Smith and his associates (Smith, 1980, 1986; Smith and Ascough, 1985; Smith and Smoll, 1982). It is a cognitive behavioral approach designed to provide the client with both cognitive and behavioral coping skills. While the SMT framework focusses on intervention strategies aimed specifically at the athlete and stress management, it should be noted that it does not deal specifically with increasing athletic pain tolerance.

The SMT program is divided into five distinct, but related phases: 1) pretreatment assessment, 2) treatment rationale, 3) skill acquisition, 4) skill rehearsal, and 5) post-treatment evaluation (Smith and Ascough, 1985). Crocker (1988) outlines the purpose of each phase of the SMT program.

Pretreatment assessment

Purpose of the pretreatment assessment phase is not only to discover the skills required for success, but also to specify the athletes behavioral and cognitive skills and deficits.

Treatment rationale

In the treatment rationale phase, the SMT conceptual model is introduced to

the athlete in order to help the athlete understand the nature of the stress response and to provide a rationale for the treatment. The program must make sense to the athlete or he\she will be less likely to comply with the training program.

Skill acquisition

The skills acquisition phase involves the training of athletes in somatic and cognitive skills. Two skills are taught in this phase: 1) the acquisition of muscle relaxation drills using a variant of Jacobson's (1929) procedure of deep muscle relaxation and, 2) the identification of dysfunctional self-statements and the replacement of these with positive, functional cognitions through the use of cognitive structuring and self-instructional training (Smith and Smoll, 1982).

Skill rehearsal

This phase gives athletes the opportunity to practice their newly acquired knowledge and skills. SMT employs a procedure known as induced effect to facilitate effect practice sessions. Induced effect requires an athlete to imagine a stressful scene as vividly as possible. When the athlete reaches a high level of emotional arousal, the trainer asks the athlete to "turn it off" with the coping skills he/she has learned. Induced effect is thought to facilitate the rehearsal of cognitive and somatic coping skills under conditions of moderate to high arousal.

Post-treatment assessment

This phase involves a re-assessment of the athlete after they have received the training and have been given the opportunity to practice the newly acquired skills.

Stress Inoculation Training

Like cognitive-affective stress management training, stress inoculation training (SIT) is not a single technique, but a treatment paradigm made up of a variety of stress management techniques. It is designed not only to resolve immediate problems, but also to be applied to future situations. SIT provides an individual with a set of coping skills to deal with stressful events in the future. According to Meichenbaum (1985), SIT is designed to:

1. Teach clients the transactional nature of stress and coping.
2. Train clients to self-monitor maladaptive thoughts, images, feelings, and behaviors in order to facilitate adaptive appraisals.
3. Train clients in problem solving, that is, problem definition, consequence, anticipation, decision making, and feedback evaluation.
4. Model and rehearse direct-action, emotion-regulation, and self-control coping skills.
5. Teach clients how to use maladaptive responses as cues to implement their coping repertoires.
6. Offer practice in imaginal and behavioral rehearsal and graded assignments that become increasingly demanding, nurture clients' confidence in and utilization of their coping repertoires.
7. Help clients acquire sufficient knowledge, self-understanding, and coping

skills to facilitate better ways of handling (un)expected stressful situations.

A fundamental difference between SIT and SMT is the method used to rehearse the acquired coping skills. Unlike SMT, which uses a procedure known as induced affect (Siprelle, 1967), SIT uses a graduated stress induction method (Crocker, 1988). The graduated stress induction method of rehearsing coping skills is more conducive to pain research because of the obvious difficulty of introducing people to high levels of pain at the beginning. A second, less significant difference between SIT and SMT is that while SMT is divided into 5 overlapping phases, the SIT paradigm consists of three phases: conceptualization, skills acquisition and rehearsal and, application and follow-through. Each of these phases consists of a number of components which interact to provide effective stress and anxiety management.

Conceptualization Phase

The initial phase of SIT has two main objectives. The first is to collect data which will allow the client and the therapist to develop an understanding of the problem. This data collection can be done through interviews, imagery-based recall, self monitoring, behavioral assessment and, psychological testing. The second objective of the conceptualization phase is to enhance the client's problem solving skills by training him or her to interpret data with greater sophistication. In this way, the therapist not only conducts an assessment of the client but also

trains the client to make personal assessments as future problems arise. The kinds of questions the trainer asks, the assessment instruments employed and the therapy rationale offered, are all seen as important in the conceptualization phase (Meichenbaum and Genest, 1983).

Clients must feel comfortable with the self-disclosure of their thoughts and feelings. A desire to understand, cooperation, the conveyance of a sense of acceptance, and optimism all lead to a trusting relationship. Rodin (1979) (cited in Meichenbaum, 1985) suggested that, when a client mentions something negative, the trainer can respond with a statement such as, "It's understandable that you would feel self-critical at times and want to change." When something favorable is mentioned, the trainer could react by saying, "It is clear that you have a lot going for you." When the client believes that the trainer is sincerely interested, the client will develop a sense of efficacy and convey expectations and beliefs about treatment (Meichenbaum, 1985).

Although SIT is relatively structured and action-orientated, the trainer must be sensitive to individual needs. The trainer does not give a series of lectures on the components of stress and coping nor is he/she imposing a strict curriculum. The trainer should be collaborating with clients so that an integrative relationship can be developed. The object of SIT is not to remove stress and anxiety but to equip clients to deal with future stressful situations.

The data from the initial phase provides extensive information about probable situational, behavioral, cognitive, affective and physiological determinants of the

problem. The accumulated data must be integrated in a way that suggests possible solutions. Meichenbaum (1977) suggests that this integration can be accomplished by conducting a task analysis of effective coping sequences. This strategy involves determining situations in which change is desired and analyzing what is required to produce effective coping responses in these responses. Meichenbaum and Jaremko (1983) state that the integration process allows clients to better understand their stress and to realize that their own thoughts, feelings, and behaviors can exacerbate difficulties.

The process is further highlighted as the therapist offers a conceptual model of the clients stress reactions. The conceptual model depends upon the clients problem. For instance, anxious clients may find use for Schacter's (1966) cognitive-physiological model of emotion or Langs (1968) tripartite model of fear. Melzack and Wall's (1965) gate-control theory of pain may be described to pain patients. Bandura's (1977) model of self-efficacy may help a wide range of clients to view their problem in a new and productive way (Meichenbaum and Jaremko, 1983).

Various researchers have done component analyses to assess the effectiveness of each phase of SIT. Horan, Hackett, Buchanan, Stone, and Demchik-Stone (1977) assessed stress inoculation effectiveness using a cold pressor test. Their results suggested that the conceptualization component alone had no effect, however, in combination with the coping skills component, the conceptualization component was found effective in increasing pain tolerance (Beach, 1981).

Fremouw and Zitter (1978) used an SIT procedure that did not include an explicit conceptualization phase. The procedure, however, was still found effective in reducing speech anxiety (cited in Jaremko, 1979). Schuler, Gilner, Austrin, and Davenport (1982) also determined that speech anxiety was reduced using a SIT program that included only the rehearsal and application phases of training. However, Jaremko, Hadfield, and Walker (1980) found that subjects exposed to how stress operates (conceptualization only) showed as much improvement as the subjects with skills for stress reduction or a combination of conceptualization and skills. This conclusion, however, should be accepted cautiously because of the small number of subjects in the conceptualization only group (n=9).

In general, the majority of studies assessing component effectiveness have indicated that the total stress inoculation training package is more effective than any one component. Therefore, to get the best results, SIT should be considered as a comprehensive package with three components rather that three separate training programs.

Skills and Acquisition Phase

Once the client has a clear conceptual understanding of the stress and it's personal effect, the trainer will provide the client with the necessary stress-reducing skills. The object of the second phase is to ensure that the client develops the capacity to effectively execute coping responses. The trainer repeatedly assesses the client's attitudes and expectations for each training technique that is introduced.

In this way the trainer can develop an appreciation for the clients concerns and can consider them for each coping procedure. The trainer can also highlight any distinction between the suggested techniques and what the client has previously attempted (Meichenbaum, 1985).

Lazarus and Launier (1978) suggest that coping techniques fall into one of two categories: Instrumental or Palliative. Instrumental (problem focused) techniques are those designed to meet environmental demands and alter or change stressful situations. In other words, instrumental techniques are used in stressful situations that can be altered to be less stressful. Palliative (emotion-regulation) techniques involve responding in the most effective way to stressful situation that cannot be avoided. Situations requiring the use of the palliative techniques are stressful situations that cannot be changed in any way. According to Meichenbaum (1985) it is best to use instrumental coping first. When instrumental coping is not possible then palliative coping techniques must be used.

Hackett and Horan (1980) conducted a controlled study in acute pain to further isolate the working components in the palliative coping technique. This technique was divided into 3 categories based on Melzack and Wall's (1965) gate-control theory of pain: 1) sensory-discriminative (ie. relaxation training), motivational-affective (ie. distraction and imagery training), and cognitive-evaluative (ie. self-instructional training). Relaxation training, distraction and imagery training, and self-instructional training should be utilized in any SIT program.

Most trainers of SIT begin with relaxation training because it is easy to learn and has a good deal of face validity (Turk, Meichenbaum, and Genest, 1983) Many different procedures have been used to teach relaxation such a progressive relaxation and deep-breathing; however, no one approach seems to be more beneficial than any other. The most effective relaxation technique is usually the one that the client feels the most comfortable with.

Turk et al. (1983) summarizes how relaxation can affect pain tolerance.

> *To summarize*, relaxation reduces pain in several ways: (1) it reduces muscular tension, thereby reducing some pain; (2) it occupies your attention, short-circuiting much of the discomfort; (3) it reduces anxiety, which further helps reduce tension; (4) it provides you with something you can do before, during, or after you experience pain, especially when the pain is at low intensity, and (5) it helps you get needed rest and sleep.
>
> In addition to your being physically relaxed, relaxation helps to create a feeling of emotional calmness. Thus we can use these relaxation exercises as a way to help us close the pain gate and reduce the discomfort. In contrast, when you are tense, you tend to open the pain gate. (p. 270)

The purpose of distraction and imagery training is to learn coping skills that will aid in diverting attention away from stressful stimuli. Coping skills are usually categorized into one of two categories: distraction techniques and imagery

techniques. Distraction techniques involve one of several options: focusing attention outside of yourself, focusing on a train of thoughts, or focusing on sensations in your body. The goal of imagery techniques is to divert attention away from the stressful situation by imagining pleasant and/or different situations. Whether a person chooses to use imagery or distraction depends upon the nature of the stress and the character of the individual. The various distraction and imagery techniques are classified and explained in more detail on page 16.

It has generally been shown that self-instructions can be maladaptive and place a person into depression. If this is true, then it follows that self-talk could be uplifting, encouraging and adaptive. Meichenbaum (1985) states that all self-dialogue will occur in one of four phases: preparing for the stressor, when confronting and handling a stressful event, when feeling overwhelmed with stress, and when reflecting on coping efforts. These four phases correspond with the stages offered in the reconceptualization process.

Self-instructional training is designed to nurture a problem-solving attitude and to encourage utilization of cognitive strategies in stressful situations. Meichenbaum (1985) states that guided self-dialogue is designed to help clients to:

1. assess the demands of a given situation and plan for future stressors.
2. control negative self-defeating, stress-engendering thoughts, images, and feelings.
3. acknowledge, use, and relabel the arousal experienced.

4. cope with intense dysfunctional emotions that might be experienced.
5. "psych" themselves up to confront stressful situations.
6. reflect on their performance and reinforce themselves for having attempted to cope.

Application and Follow-Through Phase

The objectives of the third phase of SIT are the implementation of coping responses in day-to-day situations and to maximize chances of generalized change. It cannot be assumed that the skills learned in the second phase will necessarily be implemented in everyday life. To achieve this goal the trainer can employ a variety of techniques including imagery rehearsal, role-playing, and graduated in vivo practice.

Imagery rehearsal is a technique based on Wolpe's (1958) systematic desensitization paradigm (Meichenbaum 1985). The client is asked to imagine progressively more threatening scenes while relaxed. When the client begins to experience anxiety he or she is asked to imagine dealing with the situation by utilizing coping strategies. By using imagery rehearsal, clients provide themselves with a model of how to cope with stressful situations and stressful reactions.

In role-playing, the client and trainer switch roles so that the client becomes the "trainer" and the trainer becomes the "novice client". The actual client then coaches the "novice client" on how to cope with stress effectively. Janis and Mann (1977) suggest that such an approach helps to promote change, as the client is

likely to generate those strategies, arguments, examples and motivating appeals that they are most convinced of. Role-playing also provides an opportunity to assess the clients understanding of the training strategies.

The third application strategy is graduated in vivo practice. This strategy involves placing the client in progressively more stressful situations and allowing them to deal with one situation before going on to the next more stressful situation. This strategy allow clients to implement their skills in actual situations during a therapy session. Turk et al. (1983) propose that exposure to graded, experimentally induced pain may give pain patients an opportunity to use their newly acquired coping skills. Successful application of coping skills will nurture positive expectations and increase the probability that the skills will be used in everyday situations.

The SIT program does not end with the completion of the application sessions. In most stress-inoculation training programs, some form of follow-up or booster sessions are built into the training program. The training is faded out so that sessions take place bi-weekly instead of weekly. Eventually booster sessions may take place every 3-6 months to fine-tune acquired coping skills.

Each of the application techniques has been demonstrated to be successful in different situations and with different people (Hussain and Lawrence, 1978). The success of the application and follow through phase, then, may depend on the successful use of coping imagery, the use of role play and the amount of practice with real and imagined stress (Jaremko, 1979).

Research Evidence

Stress inoculation training has been employed by many different trainers in many different situations. Most SIT application has been done by mental health professionals; however, a number of investigators have trained others to conduct SIT. These include: probation officers with adolescent offenders, police officers with other police, military drill instructors with other instructors, nurses with patients, and teachers with students. It is the flexibility, portability, and multifaceted features of SIT that have resulted in its widespread use (Meichenbaum, 1985).

SIT has been shown to be effective in many varied anxiety-producing situations. Jaremko (1980) determined that SIT was more effective than no treatment in reducing self-reported anxiety and increasing self-reported confidence in performing speech behaviors. Holcomb (1986) confirmed the effectiveness of SIT in reducing severe anxiety and stress disorders by demonstrating that SIT was superior to chemotherapy in reducing stress symptoms. Roffman (1986) did not find SIT to be superior to chemotherapy and THC (delta-9-tetrahydrocannabinol), but cautioned that the results may have been different if the 90 minute SIT intervention was longer and more intense.

Wells, Howard, Nowlin, and Vargas (1986) utilized SIT with patients about to undergo surgery. They determined that state and situational anxiety was lessened as a result of SIT. No significant differences were found in subjects' trait anxiety, because this is believed to be a relatively stable variable, not affected by situational

factors or by any particular intervention. Researchers have further utilized SIT to assist students with test anxiety (Hussain and Lawrence, 1978; Kookin and Hayslip, 1984), fear of flying (Haug et al., 1987), phobias (Meichenbaum and Cameron, 1972), runners (Ziegler et al., 1982), and student attrition (Wernick, 1984). Meichenbaum (1985) argued that the accumulated evidence for the efficacy of SIT provides promising support, but that SIT is still in the preliminary stages of development and usage.

SIT has seen its greatest impact in the area of pain and pain control. The gate-control theory of pain developed by Melzack and Wall (1965) opened the "floodgate" to psychological pain therapy. The gate-control theory is a biologically based theory, but was the first to accept the psychological importance in pain control. In 1973, Melzack acknowledged the role of three psychological dimensions: sensory-discriminative (SD), the motivational-affective (MA), and cognitive-evaluative (CE). What was once considered to be the domain of medical specialists, is now becoming part of counselling and clinical psychology and,in fact, pain clinics throughout the western world are becoming heavily staffed by professionals trained in the behavioral sciences (Hackett and Horan, 1980).

Horan and Hackett (1977) completed a component analysis of SIT and determined that the education (conceptualization) phase was not significant on it's own but when the complete SIT package was combined, there was significant improvement in pain coping ability. Vallis (1984) confirmed these findings and determined that the skills acquisition phase played the most important role in the

efficacy of the entire SIT package.

Hackett and Horan (1980) isolated the three working components of the coping-skills technique as proposed by Melzack (1973). The results indicate that relaxation training (an SD procedure) produced increased tolerance whereas distraction and imagery (an MA procedure) produced increased threshold scores. Self-instruction (a CE procedure) showed no improvement at all.

Other studies have also demonstrated the effectiveness of SIT on pain tolerance. Wells et al. (1986) determined that SIT can have a positive effect on patients' experience of pain. Patients who had received SIT had significantly lower levels of reported pain than patients not receiving training, Worthington and Shumate (1981) tested the use of imagery and verbal counselling in SIT programs with women. Their results indicated that those women using imagery showed a significant improvement in pain tolerance compared to women not using imagery. Finally, Nolan and Spanos (1987) determined that social psychological strategies (stress inoculation training) are more effective than dissociation strategies (hypnotic analgesia) for increasing pain control.

CHAPTER 3

METHOD

Subjects

Forty-seven athletes (male=22, female=25) from the City of Edmonton participated in and completed the study. The athletes ranged in age from 18-50 years with a mean age of 31.6 years. Three sports, rowing, cycling, and triathlon, were represented in the study with experience ranging from novice to professional. All of the subjects were volunteer participants and signed a consent form acknowledging that the study would involve some physical discomfort and that they may withdraw from the study at any time. The project was reviewed and approved by the Faculty of Physical Education and Recreation Ethics Committee.

The subjects were randomly assigned to one of three conditions: sport-related Stress Inoculation Training (SIT), Skills Acquisition training only (SA), or control. The random assignment was administered by ranking subjects based on a baseline measure of discomfort tolerance using the wall sit. Subjects were then matched in groups of three and randomly assigned to one of the experimental groups or to the control group. Data from two subjects in the control group was contaminated because the subjects failed to accurately report discomfort levels and were unable to give their best effort on the measured task. Ultimately, there were 15 members in each group.

Design

The subjects were randomly assigned to one of three conditions: sport-related Stress Inoculation Training (SIT), Skills Acquisition training only (SA), or control. The independent variables were type of treatment (SIT, SA, or Con), and time of assessment (pretreatment1, pretreatment2, and posttreatment). The dependent measures were, 1) pretreatment and posttreatment tolerance of discomfort using the wall sit. (measured in seconds), 2) perceived discomfort ratings using a scale with evenly spaced demarcations ranging from 0 to 100 on a vertical line, 3) open-ended question asking subjects to describe how they coped with the discomfort produced by the wall sit, and, 4) a logbook recording the number of times the wall sit was practiced at home. All subjects also completed a descriptive questionnaire inquiring about competitive sport participation, age, gender, sources and effects of discomfort, and modes of coping.

Measures

Wall Sit. The wall sit is an isometric quadriceps task and is sometimes called the " phantom chair task ". The task required the subject to sit against a wall with his\her feet shoulder width apart and a " thigh's " length from the wall. This was to ensure that the thighs are parallel to the floor. This position was ensured by measuring the subjects upper leg length and drawing a chalk line on the floor this distance from the wall. The subject was instructed to hold this position for as long as possible. The subject was timed with a stopwatch from the moment he\she was

in the correct position until the subject could no longer maintain the correct position. The experimenter recorded the score as the total number of seconds that the required position was maintained. The wall sit was chosen as the instrument to measure physical discomfort because it more closely simulated the discomfort experienced in actual athletic training as compared to other measuring instruments such as the cold pressor task.

Perceived Discomfort Intensity. Perceived discomfort intensity was measured through the use of a numerical rating scale with descriptive terms at and between the extremes (Thorn and Williams, 1989). The scale consisted of evenly marked demarcations ranging from 0 to 100 on a vertical line. The descriptive anchors "no pain", "just noticeable pain", "moderate pain", and "excruciating pain" were used to correspond with pain levels of 0, 10, 50, and 100, respectively (see Appendix B). Subjects were asked every 20 seconds to report their discomfort level as well as stating their discomfort level at termination of the wall sit. Karoly and Jensen (1987) (cited in Thorn and Williams, 1989) have indicated that numerical rating scales are valid measures of pain intensity by demonstrating significant positive correlations with other measures of pain intensity, and by their sensitivity to treatment effects.

Open-Ended Question. Participants were asked to resond to an open-ended question after each wall sit exposure asking them to describe how they coped with the discomfort (see Appendix B). Subjects completed the questionnaire after each exposure. The questionnaire was used to determine how subjects coped with

discomfort and if subjects from the experimental groups utilized the methods learned in the training sessions. The responses were categorized into one of four categories. (if appropriate): (1) relaxation, (2) attention diversion, (3) self-instruction, and (4) catastrophizing.

Logbook. Subjects were asked to practice the wall sit as many as four times per week throughout the study. The logbook was used to record the number of practice sessions.

Procedure.

Prior to administering any tests, the subjects were informed that the purpose of the study was to examine how long people are able to endure situations involving physical discomfort. It was emphasized that results from the study would be strictly confidential.

In the pretreatment phase, subjects were asked to perform the wall sit for as long as possible on two separate occasions a week apart. The task was performed individually to ensure that subjects did not compete with one another. When the subject could no longer maintain the correct position the experimenter recorded the score as the total number of seconds the correct position was maintained. During the wall sit, subjects reported their discomfort levels every 20 seconds using the ratings of perceived discomfort scale (Appendix B). Immediately after completing the wall sit, subjects completed the open-ended question. Based on the pretreatment tolerance times, subjects were randomly assigned to one of three

conditions: SIT, SA or control. Fifteen subjects were assigned to each group.

In the control group, subjects performed the wall sit along with completing the perceived pain intensity measure and the open ended question on two separate occasions. Subjects in the control group did not receive any psychological training, but were contacted by telephone in order to maintain their motivation to practice the wall sit at home.

In the Skills Acquisition (SA) group, subjects were presented with coping skills in three areas: relaxation and controlled breathing, attention diversion, and self-instructional training. Relaxation training consisted of training the subjects in the Relaxation Response as developed by Benson (1984). Attention diversion involved training the subjects in three diversion techniques; imagery, external diversion, and internal diversion. Finally, subjects were taught a systematic method of applying self-talk strategies to deal with the four stages of pain. The SA program is approximately one-third of the full SIT program. The timetable for the two SA modules is shown in Appendix C.

The Stress Inoculation Training (SIT) program is an adaptation of programs designed by Turk, Meichenbaum and Genest (1983) and Meichenbaum (1985). The adaptations were made in order to make SIT more relevant for the sport setting and acute discomfort tolerance. This sport-related SIT program consists of the same three phases as the earlier SIT programs, namely; Education and Conceptualization, Skills Acquisition, and Consolidation and Application.

The SIT group involved 2 sessions, each lasting for approximately one hour.

The sessions were administered by the investigator according to the guidelines proposed by Turk, Meichenbaum, and Genest (1983) and Meichenbaum (1985). The subjects gained knowledge and experience in each of the three phases of SIT. First, subjects gained an understanding of pain perception and the physiological/psychological connection of pain based on Melzack and Wall's (1965) Gate-Control Theory of Pain. They were also taught to view discomfort as a series of four stages: preparing for the discomfort, confronting the discomfort, coping with critical moments, and reinforcing/reflecting on successful performances. Second, subjects were presented with coping skills in three areas: relaxation and controlled breathing, cognitive coping skills, and self-instructional training. Finally, subjects were given an opportunity to apply their coping techniques by placing their hand in a bucket of ice water three times for 90, 120, and 150 seconds, respectively. Following each in vivo exposure, subjects were instructed to imagine themselves performing the wall sit and experiencing the associated pain. Thus, six exposures were experienced: three in vivo, three in vitro. The timetable for the two modules is shown in Appendix C.

Posttreatment assessment occurred one week after completion of the SA and SIT programs for all subjects. The data collection procedures replicated the pretreatment sessions with exception of the descriptive questionnaire. A schematic drawing outlining the methods and procedures can be seen in Appendix B.

CHAPTER 4

RESULTS

Data Analysis

The following chapter presents the quantitative results utililized to accurately describe and evaluate the treatment effects thus allowing for valid inference from the sample. Stevens (1986) recommends that for small group sizes ($n < 20$), a more liberal significance level ($p < .10$ or.15) be utilized to increase statistical power. Even though there is a greater risk of Type I error, it is complemented by the increase in power. Because this study is primarily an exploratory controlled study designed to assess the effectivenss of SIT and SA, a liberal significance level of $p < .10$ was chosen to evaluate treatment effects.

The data for each treatment phase (pretreatment 1, pretreatment 2, and posttreatment) were analyzed using one major inferential statistical technique: analysis of variance with repeated measures (ANOVA). The ANOVA is a method of statistical inference that evaluates whether there is any systematic difference among a set of means (Glass and Hopkins, 1984).

Two different tests were utilized to determine which means differed significantly from which other means. First, a simple contrast analysis provided a representation of the mean difference between two subsets of means. Second, the post-hoc multiple comparison test selected was Fishers' Least Significant Method (LSD). The LSD method consists of multiple t-tests following an ANOVA.

Descriptive Statistics

Wall Sit. The means and standard deviations of tolerance of physical discomfort as measured on the wall sit were calculated for pretreatment 1, pretreatment 2 and posttreatment. Tables 1, 2, 3, 4, 5 and Figures 1, 2, 3, 4, 5 present the descriptive results on the wall sit as broken down by group, sport, gender, experience, and age.

Table 1

Cell means and standard deviations for tolerance times for experimental(SIT/SA) and control(CON) subjects at pretreatment and posttreatment.

TIME	N	GROUP	MEAN	STDEV
PRE 1	15	CON	171.8	50.8
	15	SIT	161.7	44.4
	15	SA	170.1	50.1
PRE 2	15	CON	167.0	53.5
	15	SIT	155.9	46.2
	15	SA	181.2	61.7
POST	15	CON	168.8	56.5
	15	SIT	193.4	50.2
	15	SA	207.3	77.5

STDEV = standard deviation, MEAN = measured in seconds CON = Control, SIT = stress inoculation training, SA = skills acquisition only.

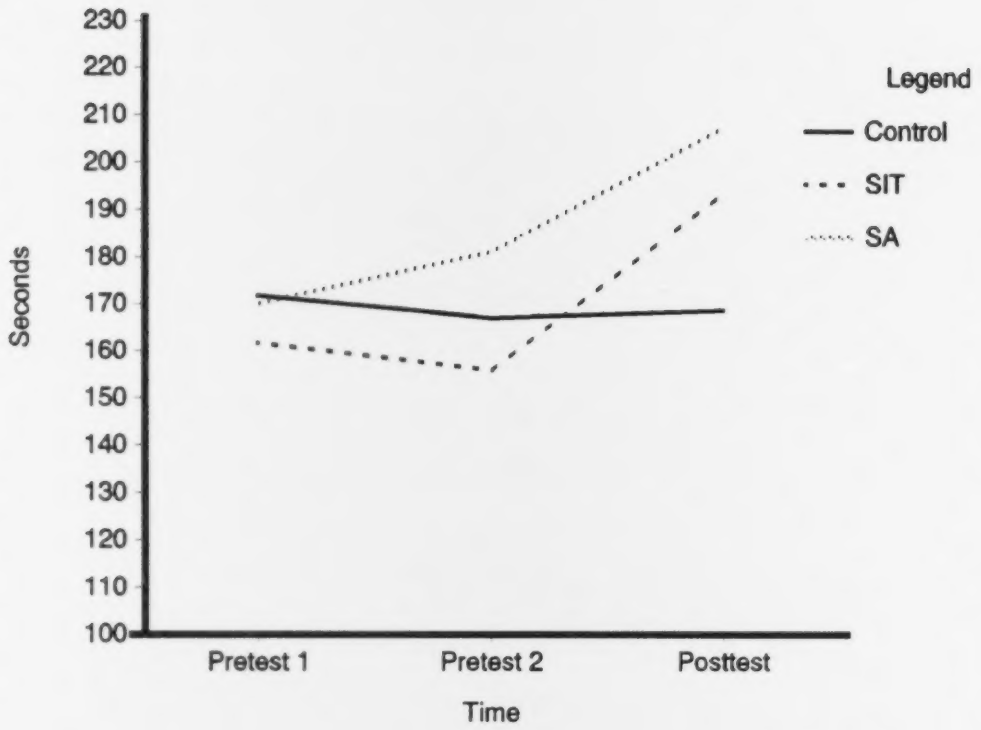

Figure 1. Cell means for tolerance times for experimental and control subjects at pretreatment and posttreatment.

Table 2

Cell means and standard deviations for tolerance times for different sport groups at pretreatment and posttreatment.

TIME	N	SPORT	MEAN	STDEV
PRE 1	24	ROWING	165.4	46.7
	5	CYCLING	164.8	40.2
	16	TRIATHLON	172.2	52.9
PRE 2	24	ROWING	171.8	60.0
	5	CYCLING	158.4	37.2
	16	TRIATHLON	165.8	51.4
POST	24	ROWING	192.5	69.2
	5	CYCLING	182.0	47.0
	16	TRIATHLON	188.6	61.8

STDEV = standard deviation, MEAN = measured in seconds.

There was little difference between the sport groups on discomfort tolerance from pretreatment to posttreatment. Subjects in the cycling group did not improve on discomfort tolerance to the same degree as subjects in the rowing and triathlon groups, however, because of the small group size this must be interpreted cautiously. Possibly the reason that the groups had similiar discomfort tolerance scores is that the sports are all individual, endurance sports in which the legs are the primary source of movement. If the sports were completely different, such as football, gymnastics and golf, the results may have been quite different.

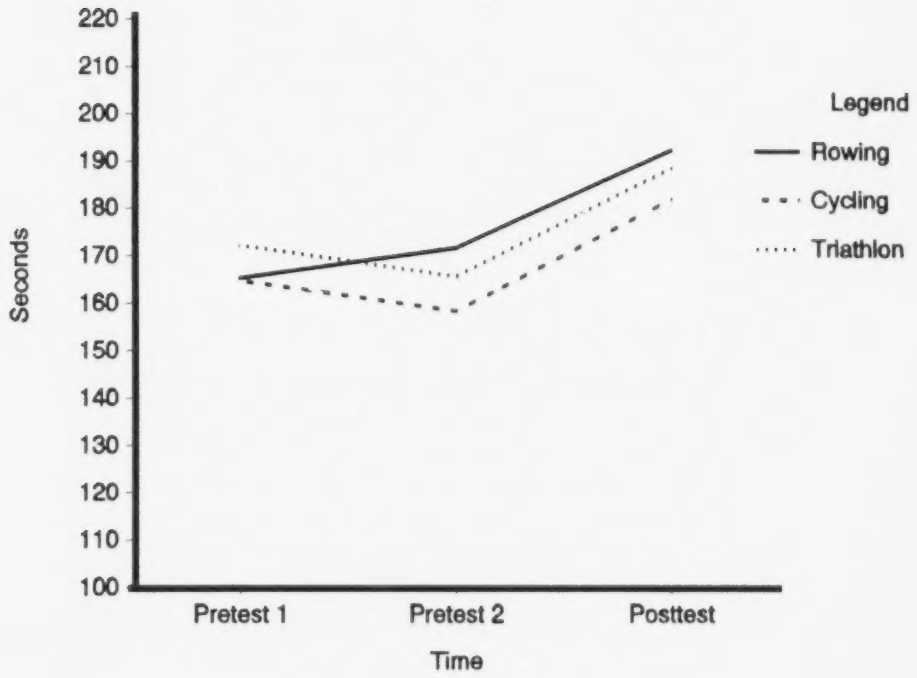

Figure 2. Cell means for tolerance times for different sport groups at pretreatment and posttreatment.

Table 3

Cell means and standard deviations for tolerance times for male and female subjects at pretreatment and posttreatment.

TIME	N	GENDER	MEAN	STDEV
PRE 1	20	FEMALE	155.1	49.5
	25	MALE	178.2	44.2
PRE 2	20	FEMALE	144.1	37.8
	25	MALE	187.1	57.9
POST	20	FEMALE	164.0	46.7
	25	MALE	210.5	67.7

STDEV = standard deviation, MEAN = measured in seconds.

The males had a much higher tolerance of physical discomfort from pretreatment to posttreatment as compared to the females. While this may actually reflect gender differences in tolerance of discomfort on the wall sit, a sociological factor may have accounted for this. North American society has generally considered the ability to tolerate high levels of pain or discomfort to be a masculine characteristic. Even in the more liberal society of the 1990's, it is more socially acceptable for a male to demonstrate a high level of physical exertion than it is for a female. Therefore, it may have been possible that the male subjects gave an extra effort on the wall sit to preserve their masculine identity while the females gave less of an effort in order to maintain their femininity.

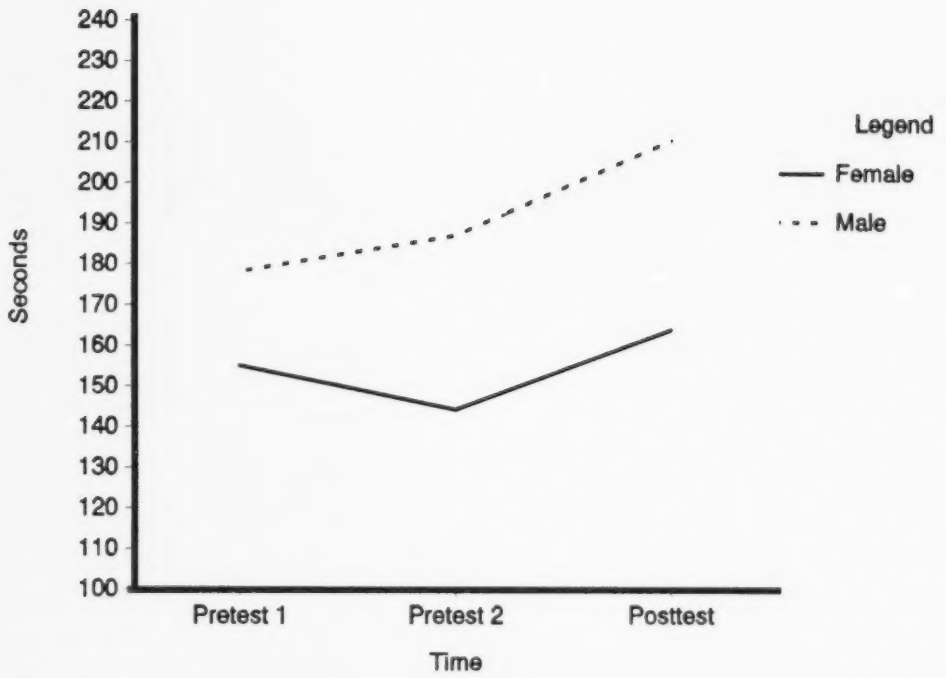

Figure 3. Cell means for tolerance times for male and female subjects at pretreatment and posttreatment.

Table 4

Cell means and standard deviations for tolerance times for different levels of subject athletic experience at pretreatment and posttreatment.

TIME	N	EXPERIENCE	MEAN	STDEV
PRE 1	20	1 YEAR	157.9	49.2
	17	2-3 YEARS	175.6	44.7
	8	4 YEARS+	176.3	50.8
PRE 2	20	1 YEAR	160.0	45.2
	17	2-3 YEARS	173.5	56.3
	8	4 YEARS+	176.4	71.8
POST	20	1 YEAR	172.4	51.6
	17	2-3 YEARS	203.3	57.2
	8	4 YEARS+	204.8	93.9

STDEV = standard deviation, MEAN = measured in seconds.

Subjects with one year of experience in their respective sport had much lower discomfort tolerance scores from pretreatment to posttreatment than subjects with two or more years of experience. This difference may be a result of leg strength difference between subjects, ie. subjects with greater athletic experience may have stonger quadriceps muscles as a result of the extra training. In this case the difference would not be a difference in discomfort tolerance but instead one of physical strength. Another reason for the difference in tolerance scores may be that subjects with more athletic experience appreciate more fully the importance of having a high tolerance of physical discomfort, and as a result, may have had a higher level of motivation during the training sessions and the wall sit.

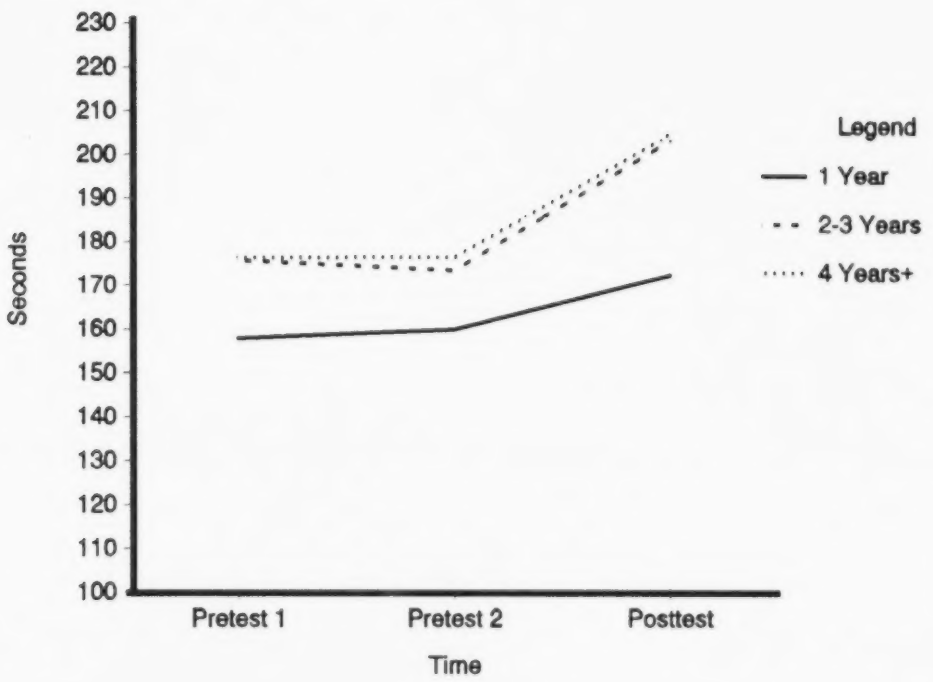

Figure 4. Cell means for tolerance times for different levels of subject athletic experience at pretreatment and posttreatment.

Table 5

Cell means and standard deviations for tolerance times for different age groups at pretreatment and posttreatment.

TIME	N	AGE	MEAN	STDEV
PRE 1	6	21 YR>	173.7	60.5
	26	21-30 YR	162.0	49.3
	11	31-40 YR	180.6	41.2
	2	40 YR+	156.5	21.9
PRE 2	6	21 YR>	169.8	58.1
	26	21-30 YR	158.3	51.3
	11	31-40 YR	193.6	57.4
	2	40 YR+	148.5	44.5
POST	6	21 YR>	197.0	59.3
	26	21-30 YR	173.0	55.9
	11	31-40 YR	226.1	76.0
	2	40 YR+	187.5	3.54

STDEV = standard deviation, MEAN = measured in seconds.

No consistent pattern was evident with regards to discomfort tolerance scores and the age of the subject. The 31-40 group was consistently higher than the other groups, however, this is more likely a result of their attitude rather than their age. In other words, most of the subjects in the 31-40 group were triathletes who were very serious about their sport and may have been more motivated, than other subjects, during the training sessions and the wall sit.

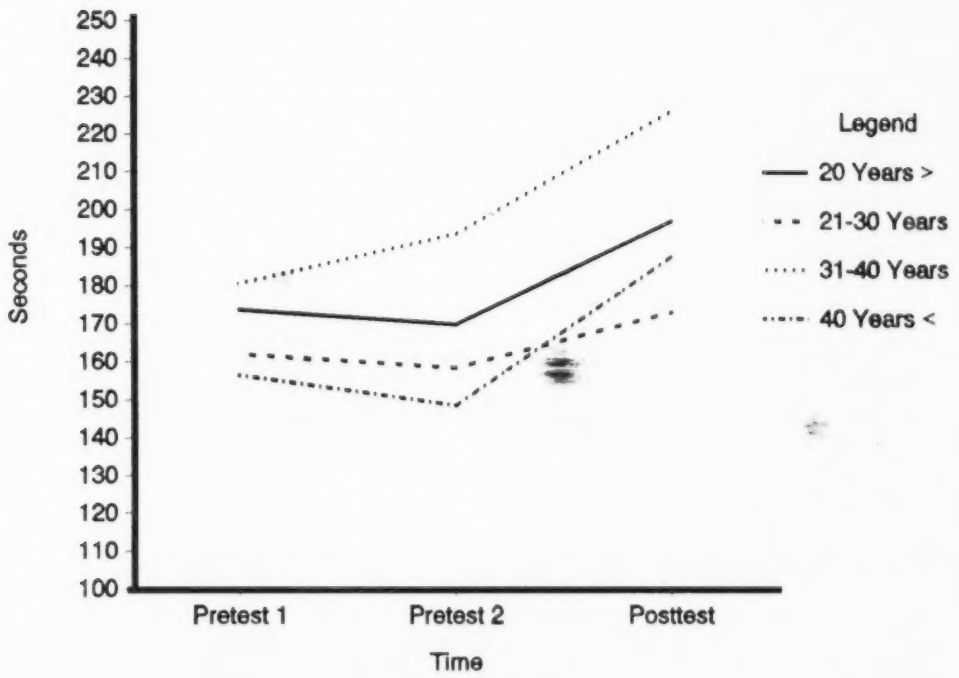

Figure 5. Cell means for tolerance times for different age groups at pretreatment and posttreatment.

Open-Ended Question. The qualitative data from the open-ended question was categorized into one of four categories (if appropriate): (1) relaxation, (2) attention diversion, (3) self-instruction, and (4) catastrophizing. Catastrophizing is a negative reaction to discomfort in which the subject makes irrational statements about the severity of the discomfort. The results shown in Table 6 and Figure 6 and 7 give indication as to whether or not the subjects in the training groups utilized the discomfort control strategies taught in the training sessions.

Table 6

Percent of cognitive-behavioral methods of discomfort tolerance utilized by experimental(SIT/SA) and control(CON) subjects during pretreatment and posttreatment.

TIME	GROUP	CAT	REL	DIV	SEL
PRE 1	CON	27	27	35	11
	SIT	33	19	41	7
	SA	32	16	40	12
PRE 2	CON	30	30	36	4
	SIT	26	21	53	0
	SA	20	20	40	20
POST	CON	23	18	41	18
	SIT	0	48	35	17
	SA	0	41	35	24

CAT=catastrophizing, REL=relaxation strategies, DIV=attention diversion strategies, SEL=self-instructional strategies.

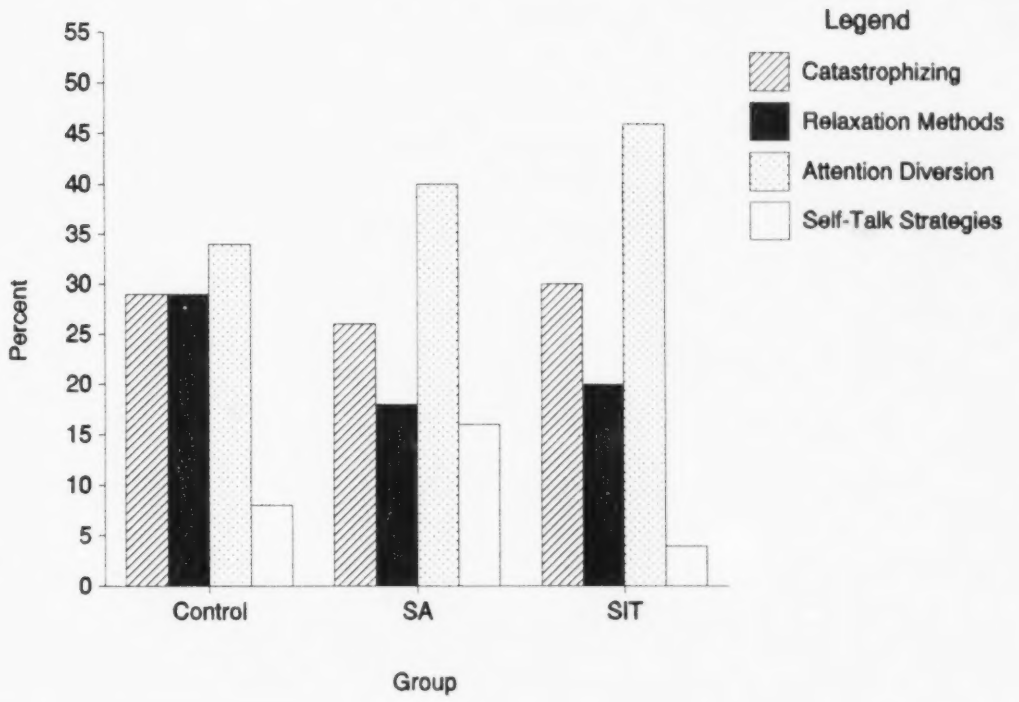

Figure 6. Cognitive-behavioral methods of discomfort tolerance utilized by experimental(SIT/SA) and control(CON) subjects during pretreatment 1 and pretreatment 2 combined.

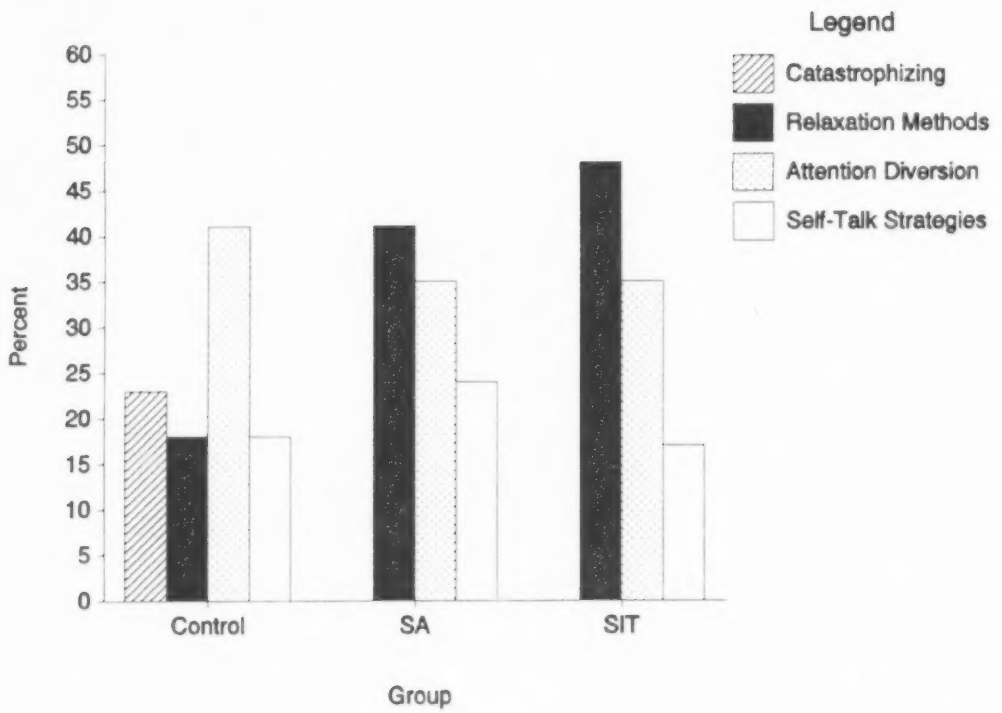

Figure 7. Cognitive-behavioral methods of discomfort tolerance utilized by experimental(SIT/SA) and control(CON) subjects at posttreatment.

The results indicate that subjects in the training groups showed a difference in strategy utilization from pretreatment to posttreatment. Subjects in the training groups utilized relaxation strategies and self-instructional strategies in the posttreatment more often than in the pretreatment while decreasing their use of catastrophizing. The control group showed no difference in their use of discomfort control strategies from pretreatment to posttreatment.

An important point to consider is using the cognitive-bahavioral methods of discomfort control during the wall sit and using them during actual sport competition is quite different. Sports that involve the same repetitive movements for an extended period of time such as running and cycling may find it appropriate to use any of the cognitive-behavioral methods. However, athetes in sports such as figure skating, hockey, or tennis will find it difficult to utilize some of the methods such as attention diversion or relaxation training. It is recommended that for athletes in sports that require a high level of concentration that self-instructional strategies may be the most helpful.

Logbook. Subjects were asked to practice the wall sit as much as four times per week and record each practice in the provided logbook. Subjects in the skills acquisition (SA) and the stress inoculation training (SIT) groups reported practicing the wall sit an average of 6.94 and 7.20 times, respectively, over the four week period. This was slightly higher than the control group which practiced an average of 6.27 times over the four week period. However, the difference is very small and not significant (see Figure 8).

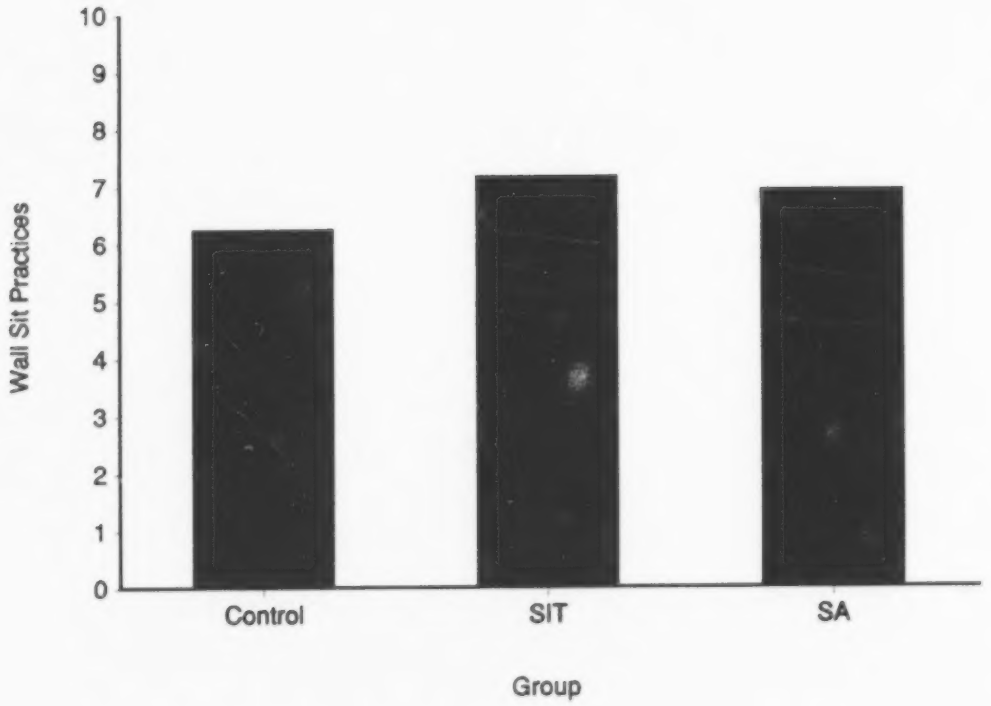

Figure 8. Number of wall sit practices over a 4 week period by experimental(SIT\SA) and control(CON) subjects.

Inferential Analysis

Hypothesis 1:

The SA treatment group and the SIT treatment group will have significantly higher tolerance of physical discomfort compared to the control group from pretreatment to posttreatment.

Results:

An ANOVA of repeated measures was used to test this hypothesis (see Table 7). Subjects ratings of perceived discomfort during the wall sit changed significantly from pretreatment to posttreatment ($p=.09$). There was no group main effects on the posttreatment measure of pain tolerance, however, there was a significant group X time interaction effect ($p=.048$).

Table 7

Summary of repeated measures ANOVA output for pretreatment and posttreatment results.

MEASURE	TIME	DF	MS	F	P
RPD	PRETREAT 1	2,42	12.4	1.78	.180
	PRETREAT 2	2,42	5.4	1.03	.363
	POSTTREAT	2,42	28.3	2.55	.090
PAINTOL	PRETREAT 1	2,42	436.7	0.19	.831
	PRETREAT 2	2,42	2418.4	0.82	.446
	POSTTREAT	2,42	5254.3	1.33	.276
MEASURE	EFFECT	DF	MS	F	P
PAINTOL	GROUP	2,42	7518.8	0.50	.608
	TIME	2,84	860.8	7.90	.001
	GROUP BY TIME	4,84	860.8	2.51	.048

PAINTOL = pain tolerance as measured on the wall sit, RPD = ratings of perceived discomfort at wall sit termination.

After performing the Least Significant Difference post hoc analysis (see Table 8), it revealed that both the SA and SIT treatment groups were not significantly different than the control group. However both the SA and SIT treatment groups improved significantly from pretreatment to posttreatment while the control group did not. Hence, the first hypothesis was partially supported in that while the treatment groups were not significantly different than the control group they did show significant improvement from pretreatment to posttreatment.

Table 8

Summary of observed differences utilizing the Least Square Difference method of multiple comparison for pretreatment and postreatment discomfort tolerance.

	CON1	CON2	CON3	SIT1	SIT2	SIT3	SA1	SA2
CON1								
CON2	-4.8							
CON3	-3.0	1.8						
SIT1	-10.7	-5.3	-7.1					
SIT2	-15.9	-11.1	-12.9	-5.9				
SIT3	21.6	26.4	24.6	31.7*	37.5*			
SA1	-1.7	3.1	1.3	8.4	14.3	-23.3		
SA2	9.4	14.2	12.4	19.5	25.3	-12.2	11.1	
SA3	33.7	38.5	36.7	43.8*	49.7*	12.1	35.3*	24.3*

*p < .05

CON = control group at pretreatment 1,2 and posttreatment, SIT = stress inoculation training group at pretreatment 1, 2 and posttreatment, SA = skills acquisition group at pretreatment 1, 2 and posttreatment.

Hypothesis 2:

The SIT treatment group will have significantly higher tolerance of physical discomfort compared to the SA treatment group from pretreatment to posttreatment.

Results:

A simple contrast analysis was used to test this hypothesis (see Table 9). There was no significant difference between the SA and SIT treatment groups from pretreatment to posttreatment. In fact the SA treatment group improved slightly more than the SIT treatment group but it was not a significant difference. Hence, the second hypothesis was not supported. However, in terms of change, subjects in the experimental groups improved significantly compared to the control group.

Table 9

Summary of contrast analysis output for pretreatment and posttreatment results.

CONTRAST	DF	T	P
CON1-SIT1 = CON2-SIT2	84	-.07	.944
CON1-SIT1 = CON3-SIT3	84	2.29	.025
CON2-SIT2 = CON3-SIT3	84	2.36	.021
CON1-SA1 = CON2-SA2	84	1.05	.298
CON1-SA1 = CON3-SA3	84	2.53	.013
CON2-SA2 = CON3-SA3	84	1.49	.140
SIT1-SA1 = SIT2-SA2	84	1.11	.267
SIT1-SA1 = SIT3-SA3	84	.246	.806
SIT2-SA2 = SIT3-SA3	84	-.87	.386

CON = control group at pretreatment 1,2 and posttreatment, SIT = stress inoculation training group at pretreatment 1, 2 and posttreatment, SA = skills acquisition group at pretreatment 1, 2 and posttreatment.

Hypothesis 3:

The SA treatment group and the SIT treatment group will have significantly lower subjective discomfort ratings from pretreatment to posttreatment.

Results:

Even though the ratings of perceived discomfort scale is an interval scale (ie. 40 is twice as much as 20), when the subjects are asked to rate their discomfort level they did not assume an interval scale (ie. subjects did not perceive 10-20 as the same interval as 90-100). This was determined by asking subjects upon completion of the wall sit. Therefore, a non-parametric analysis was necessary with the Chi-Square test chosen as the tool to test this hypothesis. The Chi-Square test is a non-parametrical test that is used to determine the statistical significance of the difference between the reported frequency scores. In this situation, the Chi-Square test is used to analyze the difference between the perceived discomfort scores from pretreatment to posttreatment.

Analysis was conducted comparing pretreatment 1 with posttreatment and pretreatment 2 with posttreatment. There were significant differences for both the SA and the SIT treatment groups on pretreatment 1 vs. posttreatment. However, significance was limited to one point (120 seconds) with the SIT treatment group. There were also significant differences for both the SA and SIT treatment groups on pretreatment 2 vs. posttreatment, especially for the SIT treatment group. A summary of the results can be seen in Table 10.

Hypothesis 4:

The control group will not have significantly lower subjective discomfort ratings from pretreatment to posttreatment.

Results:

In the same way that hypothesis 3 was tested, a Chi-Square test was used to test this hypothesis. There were no significant differences in perceived discomfort levels from pretreatment 1 vs. posttreatment or from pretreatment 2 vs. posttreatment. A summary of these results can be seen in Table 10.

Table 10: Summary of chi square output for RPD scores for pretreatment and posttreatment results.

PRETREATMENT 1 vs. POSTTREATMENT

TIME	CONTROL		SA		SIT	
	Chi	Sig	Chi	Sig	Chi	Sig
20 sec	.60	.438	1.07	.301	.27	.606
40 sec	.00	1.00	4.27	.039**	1.67	.197
60 sec	.07	.796	2.40	.121	1.67	.197
80 sec	.60	.439	3.27	.071*	1.67	.197
100 sec	.00	1.00	4.27	.039**	2.40	.121
120 sec	.27	.606	4.27	.039**	3.27	.071*
140 sec	.00	1.00	1.67	.197	1.07	.302
160 sec	.00	1.00	.27	.606	2.40	.121
180 sec	.27	.606	1.67	.197	1.67	.197
200 sec	.07	.796	.60	.439	1.07	.301
220 sec	.27	.606	.27	.606	.60	.439
240 sec	.00	1.00	.60	.439	.07	.796
260 sec	.00	1.00	.27	.606	.07	.796
280 sec	.00	1.00	.07	.796	.07	.796
300 sec	.00	1.00	.07	.796	.07	.796

PRETREATMENT 2 vs. POSTTREATMENT

TIME	CONTROL		SA		SIT	
	Chi	Sig	Chi	Sig	Chi	Sig
20 sec	.07	.796	2.40	.121	4.27	.039**
40 sec	.27	.606	1.67	.197	6.67	.009**
60 sec	.27	.606	.27	.606	1.67	.197
80 sec	.07	.796	3.27	.071*	4.27	.039**
100 sec	.27	.606	4.27	.039**	6.67	.009**
120 sec	1.67	.197	4.27	.039**	6.67	.009**
140 sec	1.67	.197	2.40	.121	4.27	.039**
160 sec	.60	.439	2.40	.121	3.27	.071*
180 sec	.60	.439	2.40	.121	1.67	.197
200 sec	.07	.797	.07	.797	1.07	.302
220 sec	.60	.439	.27	.606	.60	.439
240 sec	.00	1.00	.60	.439	.07	.797
260 sec	.07	.797	.27	.606	.07	.606
280 sec	.00	1.00	.07	.797	.07	.797
300 sec	.00	1.00	.07	.797	.07	.797

*=p<.10, **=p<.05.

SA=skills acquisition, SIT stress inoculation training, Chi=chi square, Sig=significance level

CHAPTER 5

DISCUSSION

This final chapter will summarize the present study and review the results. A thorough discussion of the dependent measures will be followed by implications and suggestions for future research in discomfort tolerance in athletic settings.

Summary

The purpose of the study was to investigate and compare the effectiveness of Stress Inoculation Training and one if its phases, Skills Acquisition, in increasing tolerance of physical discomfort in competitive athletes. The SIT program is a cognitive-behavioral treatment paradigm made up from a variety of stress management techniques (Meichenbaum, 1985). The target sample for this study were endurance athletes from three different sports: rowing, cycling, and triathlon. Subjects in the treatment groups received two-one hour training sessions one week apart while the control subjects did not receive any training. The primary assessment period was two pretreatment trials and a posttreatment trial. The study had four hypotheses which will be considered below in a review of the dependent measures.

Discomfort Tolerance

Discomfort tolerance was measured through the use of the "wall sit" which is a quadriceps endurance task. Consistent with previous research (Nolan and Spanos, 1987, Wells and Howard, 1986, and Worthington and Shumate, 1981), subjects in the treatment groups had a significantly higher tolerance of discomfort than the control group from pretreatment to posttreatment. The SA and SIT treatment groups improved 21% and 19% respectively, while the control group had 0% improvement. Based on qualitative data , subjects in the treatment groups used more relaxation and self-instructional strategies during the posttreatment trial while the control group showed no difference in their use of coping methods. This difference in the use of coping strategies is probably the major reason for the increase in discomfort tolerance for subjects in the treatment groups.

Contrary to what was expected, there was no difference in tolerance of discomfort between the SA and the SIT treatment groups. There are at least two explanations for this result. First, the training sessions were done on a group basis and were short in duration. As a result, the training sessions in the conceptualization and application phases of SIT might not have been long enough to be truly effective. If the training sessions were longer and done on an individual basis the results might have been different. Second, a secondary purpose of the study was to examine the effectiveness a cognitive-behavioral training regimen administered over a short period of time (3 weeks). A longer training period may have resulted in a greater contribution from the conceptualization and application

phases of Stress Inoculation Training. Regardless, in this study, the skills acquisition phase played the most important role in the efficacy of the entire SIT package as evidenced by the improvement in discomfort tolerance in the Skills Acquisition group.

Perceived Discomfort Level

Subjects were asked to rate their discomfort levels every 20 seconds throughout the wall sit. The purpose of the periodic rating was to determine not only the level of physical discomfort caused by the wall sit but to also determine the "subjective path" people took to reach their highest level of physical discomfort. Subjects rated themselves using a Rating of Perceived Discomfort scale that was placed in front of them during the wall sit. The difficulty with the scale is that even though the scale was intended to be an interval scale, in reality, the subconscious assumptions made by the subjects caused the scale to be an ordinal scale. In other words, subjects did not see the difference between 10-20 on the scale as being the same difference as 90-100. As a result, nonparametric statistics had to be used for the analysis of the perceived discomfort data. Unfortunately, nonparametric statistics are less powerful and more limited than parametric statistics.

As expected, subjects in the SA and SIT treatment groups had significantly lower subjective discomfort ratings from pretreatment to posttreatment. The improvement in perceived discomfort ratings were the greatest for the SIT treatment group from pretreatment 2 to posttreatment. This provides evidence that

even though the SIT treatment group was no different than the SA treatment group in increasing their ability to tolerate physical discomfort, the SIT treatment group viewed the physical discomfort in a more realistic manner. This is a result of training in the conceptualization phase in which subjects are taught that pain\discomfort can be controlled through psychological skills training. Possibly, if the training was longer in duration the difference between the SA and the SIT treatment groups would have been even greater. The control group did not show any significance difference in their subjective ratings of physical discomfort from pretreatment to posttreatment.

Implications

The SIT program appears to be effective across many diverse populations including patients suffering from chronic pain. The research evidence has important implications for the physical training and psychological development of athletes even though the use of SIT to assist athletes in increasing their tolerance of physical discomfort has been limited. Before coaches and athletes implement a cognitive-behavioral program, he/she must have an appreciation of the practical implications of the SIT program and this study.

Stress Inoculation Training can be carried out with individuals, couples, and groups, with the training varying in length from as short as 1 hour with patients about to undergo surgery to 40 one-hour sessions administered to psychiatric patients. With most pain patients, SIT consists of 12-15 sessions, plus booster and

follow-up sessions faded over a 6 to 12 month period (Meichenbaum, 1985).

The pain experienced by someone suffering from terminal cancer and a marathon runner experiencing physical discomfort in the late stages of a race are completely different. The cancer patient has chronic pain that is with them every moment of the day and often until death, however, the athlete experiences acute discomfort that is instantly relieved when the race is completed. Therefore, the amount of psychological training required to control physical discomfort is much less than to control chronic pain from illness. This study demonstrated that two-one hour training sessions were effective in assisting athletes to increase their tolerance of physical discomfort.

The SIT program can be administered easily and thus integrated into the technical and physical training program to promote a more holistic development of the endurance athlete. The conceptual model of the Gate-Control theory of pain helps athletes to appreciate the integrated role of mental and physical skills in improving tolerance of physical discomfort. As well, the endurance athletes' training program consists of long hours in a relatively mundane activity, therefore, mental coping skills can be easily incorporated into the endurance athletes training schedule.

A major challenge facing all coaches and athletes is breaking traditional practice boundaries so that coping skills can be more easily acquired, developed, and applied in sport (Crocker, 1988). Introducing a cognitive-behavioral program to endurance athletes should not be a major challenge because physical discomfort

is so evident in those sports that athletes are always searching for a better method of handling it. This present study clearly demonstrates that SIT and SA increased tolerance of physical discomfort beyond that attained by the control subjects not exposed to psychological training. It is important that the practice and use of mental coping skills go beyond the laboratory and begin to be utilized in actual practices and competitions.

A major positive feature of the SIT program is the flexibility within the program to allow for individual differences. The athletes have the flexibility to be able to switch from one mental coping method to another depending on what the situation requires. In a given situation it may be most beneficial to use a relaxation procedure while in another situation it is most beneficial to use self-instruction.

Suggested Future Research

The present study provided evidence that SIT administered over a relatively short period of time is an effective program to enable athletes to improve their tolerance of physical discomfort thereby improving performance. Suggestions for future research will be advanced to strengthen the generalizability of the SIT program and to further our understanding of the physical discomfort dimension of endurance athletics.

It is often said that sport is just a small scale replica of real life. Further replications and applications of SIT with athletic populations will help to

distinguish if the results from earlier studies would also be true with athletes. Folzman and Lazarus (1980) found that people changed coping patterns from work to interpersonal situations. It is plausible that due to the unique social, psychological and physiological factors involved in the sport setting, patterns of coping may be qualitatively different from other situations and may be different within various levels of competition (Crocker, 1988).

Psychological skills can be taught in a short period of time but it takes longer for the athlete to become effective in using the skills. Athletes will train hours upon hours in physical and technical training and then spend only a few minutes on psychological training. Just as with physical training it takes many hours to become effective at using psychological skills. Future studies utilizing the SIT package with athletes should consider working with the athletes on an individual basis over a longer period of time. For example, having 30 minute training sessions once per week for a period of 4-6 months. This would allow subjects to comprehend the material in a shorter one-on-one session and give them more opportunity to practice the skills. This may be done most effectively by doing a field type study in a single subject design with 5-6 subjects. As a result, SIT training may prove to be even more effective than demonstrated in this present study.

Conclusion

Endurance athletes have indicated that the ability to tolerate high levels of athletic pain or discomfort accounted for much of their success (Egan, 1987). This was a controlled pretest-posttest exploratory study that investigated and compared the effectiveness of Stress Inoculation Training and one of its components, Skills Acquisition, in increasing athletic tolerance of physical discomfort. Stress Inoculation Training is a comprehensive treatment paradigm made up from a variety of stress management techniques and consisting of three different phases: Conceptualization, Skills Acquisition, and Application.

The data from the dependent measures as well as the open-ended question, provided evidence that SIT and SA can help athletes increase their ability to tolerate high levels of physical discomfort during training and competition. Evidence that SIT is effective supports the need for more rigorous experimental studies to determine the underlying reasons for its effectiveness. It is important that sport researchers and clinicians begin to recognize the importance of a high level of discomfort tolerance in athletics and begin to advance the knowledge of effective coping of discomfort in athletic settings.

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APPENDIX A

COGNITIVE-BEHAVIORAL PAIN MANAGEMENT PROGRAM FOR ATHLETES

COGNITIVE-BEHAVIORAL PAIN MANAGEMENT PROGRAM FOR ATHLETES

by Blair Whitmarsh (1990)

INITIAL PHASE

A Situational and Cognitive-Affective Analysis.

Questions for the Coach to ask the athlete:

1. What does you pain feel like? Describe it?
2. When does your pain occur?
3. Is the pain during competition continuous or intermittent?
4. What actions make the pain worse?
5. What things are you unable to do in training or competition due to pain?
6. What do you do to relieve pain?
7. Are you confident in your methods for controlling pain?

SECOND PHASE

Education and Conceptualization.

- Educate the athlete on pain perception and the physiological/psychological connection based on Melzack and Wall's (1965) Gate-Control Theory of Pain.
- Encourage athlete to view pain as a series of four stages: preparing for the pain, confronting the pain, coping with critical moments, and reinforcing and\or reflecting on successful performances.

THIRD PHASE

Skill Acquisition and Consolidation.

- Encourage appropriate and successful implementation of athletes' existing coping skills.
- Arrange acquisition of any essential coping skills that may be missing.
- Encourage athlete to feel confident that the coping skills acquired will work in an aversive situation.

Skills:

1. Cue-Controlled Relaxation and Controlled Breathing.

- Reduces pain by:
  - A. Reducing muscle tension.
  - B. Diverting attentional focus.
  - C. Reducing anxiety.
- Use the Relaxation Response and Niedeffer's "Centering".
- Helps athletes know if they are tense or relaxed in training or competition.
- Reduces anxiety and tension which acts to close the pain gate and reduce discomfort.(Gate-Control Theory)

2. Cognitive Coping Skills Training.

Train athletes in these skills:

(A) Imaginative Inattention
- ignoring the pain by engaging in imagery which is incompatible with the pain experience. ie. going to the beach.

(B) Imaginative Transformation of Pain
- acknowledging the noxious sensations, but interpreting them as trivial or unreal.

(C) Imaginative Transformation of Context
- acknowledging the noxious sensations, but transforming the setting or contest. ie. picturing oneself as " James Bond " having been shot in the limb.

(D) Attention-Diversion (external)
- focussing attention on physical characteristics of the environment. ie. looking at the clouds or counting

telephone poles.

(E) Attention-Diversion (internal)
- focussing attention on self-generated thoughts. ie. doing mental arithmetic, making lists of favorite songs or mentally building a house from scratch.

(F) Association
- focussing on internal physiological characteristics such as heart and breathing rates while reminding oneself to "stay cool" and "relax".

(G) Somatization
- focussing on the part of the body receiving the intense stimulation, but in a detached manner. ie. analyzing the intense stimulation and sensations as if to write a biology report.

3. Self-Instructional Training

Four Parts:

1. Prepare for Intense Stimulation Before it is too Strong.

(A) What is it I have to do? (view the situation as a problem you can handle)
(B) Just think about what I have to do. (focus on what the situation requires)
(C) Think of the strategies I can use to help cope. (review cognitive coping skills)
(D) Don't worry; it won't help anyway. (use anxiety and worry as a reminder to focus on the task)
(E) Remember my past experiences in pain control. (reassurance about the ability to use cognitive strategies)

2. Confronting and Handling the Situation.

(A) I can handle this aversive situation. (view the situation as a challenge to tackle)
(B) Just relax, breathe deeply and use one of the strategies. (use cognitive coping skills)
(C) Don't think about the pain. (focus attention on the task at hand)
(D) Remember, I can switch to other cognitive strategies if necessary. (if current strategy is not working then consider switching)

3. Coping with Thoughts and Feelings at Critical Moments.

(A) When I feel pain, keep focussing on what I have to do.
(B) Don't try to eliminate pain totally, just keep it manageable.
(C) I knew pain sensations would arise, just keep them under control.
(D) Remember, I know a lot of pain control strategies.
(E) If I feel terrible, I must relax and focus on things under my control.

4. Self Reflection and Positive Self-Statements.

(A) I knew I could handle it! I am doing well.
(B) I did it! I know I will control my pain the next time it happens.

FINAL PHASE

Application

(A) Encourage athletes to experiment with the various cognitive skills of pain control in training.
(B) Encourage athletes to choose 1 or 2 cognitive pain control methods that are most effective for them.
(C) Allow the athletes plenty of opportunities to practice the effective cognitive pain control strategies.
(D) Provide the athlete with success experiences in controlling pain.
(E) The athlete who is successful in controlling pain with cognitive methods will have a higher level of self-efficacy.
(F) The higher the level of self-efficacy, the more likely the athlete will choose to use a cognitive pain control method in future aversive situations.

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APPENDIX B

METHODOLOGICAL CONSIDERATIONS

INFORMED CONSENT FORM

Title: The Role of Mental Skills Training in Increasing Athletic Pain Tolerance

Investigators: Blair Whitmarsh 482-7496
Rick Alderman 492-3839

Purpose: The purpose of this study is to investigate and compare the effectiveness of two mental skills training programs in increasing tolerance of physical discomfort in recreational and competitive athletes.
The identity of the subjects will be kept confidential by assigning a number to each subject.
Subjects will be required to perform the wall sit on three different occasions.
Subjects in the treatment groups will be required to attend two trainng sessions.
Total time required of the subjects is 2-3 hours.
Prior to and on completion of the wall sit, subjects will be required to complete a descriptive questionnaire and an open-ended question.

* If you do not understand the procedures, please ask the investigator immediately.*

* If at any time you want to withdraw from the study, you may do so without any consequences.*

I, the subject, understand the above information and give my consent to participate In this study. I acknowledge that I received a copy of the signed consent form.

Name	Date
Investigator	Witness

A STUDY OF ATHLETIC PAIN TOLERANCE

Purpose: **The purpose of this study is to determine how endurance athletes tolerate high levels of physical discomfort and to provide participants with psychological training to assist with the tolerance of high levels of physical discomfort.**

Benefits: **Participants will develop a greater understanding of the importance of psychology in sport performance.**

Participants will gain and understanding of the psychological aspects of athletic pain tolerance.

Participants will receive psychological training to assist them with the toleration of high levels of physical discomfort experienced in their sport thus causing an improvement in performance.

Method: **Participants will be asked to perform quadriceps endurance task for as long as possible on three different occasions.**

After the second occasion, participants in the two training groups will receive psychological training to assist with the toleration of the physical discomfort experienced in the wall sit.

Participants will be told which test group they will be in at the second test session.

Time Required: **Participants will be required to perform the quadriceps endurance task on three different occasions, one during each of the weeks of June 10-14, June 17-21, and July 8-12.**

Participants in the two training groups will be required to attend two, one hour, psychological training sessions, during the period of June 24-28 and July 2-5.

Participants in the control group will be required to attend one, one hour, session in the beginning of July.

Participants in the control group will have the opportunity to attend a psychological training session, identical to that received by the training groups, at the completion of the study.

All sessions will take place at the University of Alberta, Van Vliet Building, Room E120 or Room W-01 in the evening.

Participants will also be encouraged to practice the quadriceps endurance task on their own time and will be asked to keep a record book.

Total Time = 2-3 hours (approximately)

If you have any question please contact the investigator, Blair Whitmarsh, at 482-7496.

DESCRIPTIVE QUESTIONNAIRE

1. NAME:_____

2. ADDRESS:_____

_____

3. AGE?_____

4. GENDER?_____

5. WHAT IS YOUR SPORT?_____

6. HOW LONG HAVE YOU COMPETED IN YOUR SPORT?_____

7. HOW MANY HOURS PER WEEK DO YOU TRAIN FOR YOUR SPORT?

IN THE OFF-SEASON?_____

IN THE COMPETITIVE SEASON?_____

8. DO YOU EXPERIENCE HIGH LEVELS OF PHYSICAL DISCOMFORT WHILE TRAINING OR COMPETING IN YOUR SPORT?_____

9. IF YES, HOW DO YOU DEAL WITH THE PHYSICAL DISCOMFORT?

_____

_____

_____

_____

11. HAVE YOU EVER RECEIVED PSYCHOLOGICAL TRAINING IN MENTAL SKILLS TO ASSIST IN ATHLETIC PERFORMANCE?

_____

12. IF YES, WHAT TYPE OF TRAINING DID YOU RECEIVE?

_____

_____

_____

Ratings of Perceived Discomfort
Record Sheet

SUBJECT:_____

RPD

20 SECS:_____

40 SECS:_____

60 SECS:_____

80 SECS:_____

100 SECS:_____

120 SECS:_____

140 SECS:_____

160 SECS:_____

180 SECS:_____

200 SECS:_____

220 SECS:_____

240 SECS:_____

260 SECS:_____

280 SECS:_____

300 SECS:_____

320 SECS:_____

340 SECS:_____

360 SECS:_____

380 SECS:_____

400 SECS:_____

420 SECS:_____

440 SECS:_____

460 SECS:_____

480 SECS:_____

500 SECS:_____

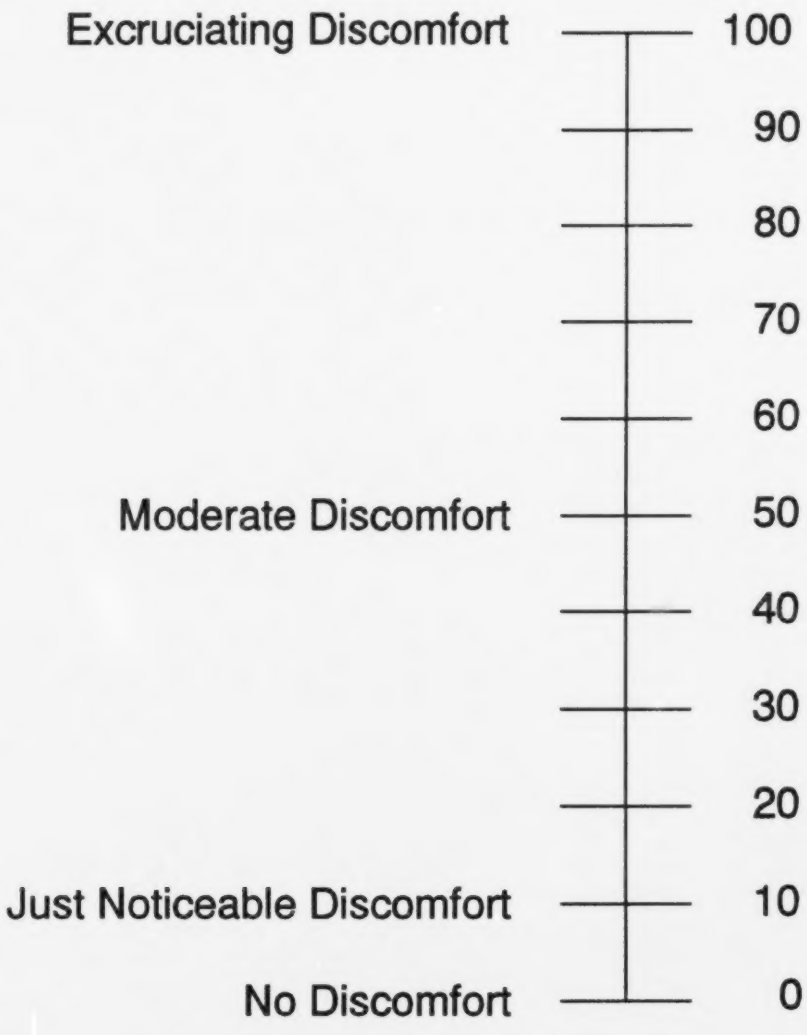
520 SECS:_____

Termination

TIME:_____

RPD:_____

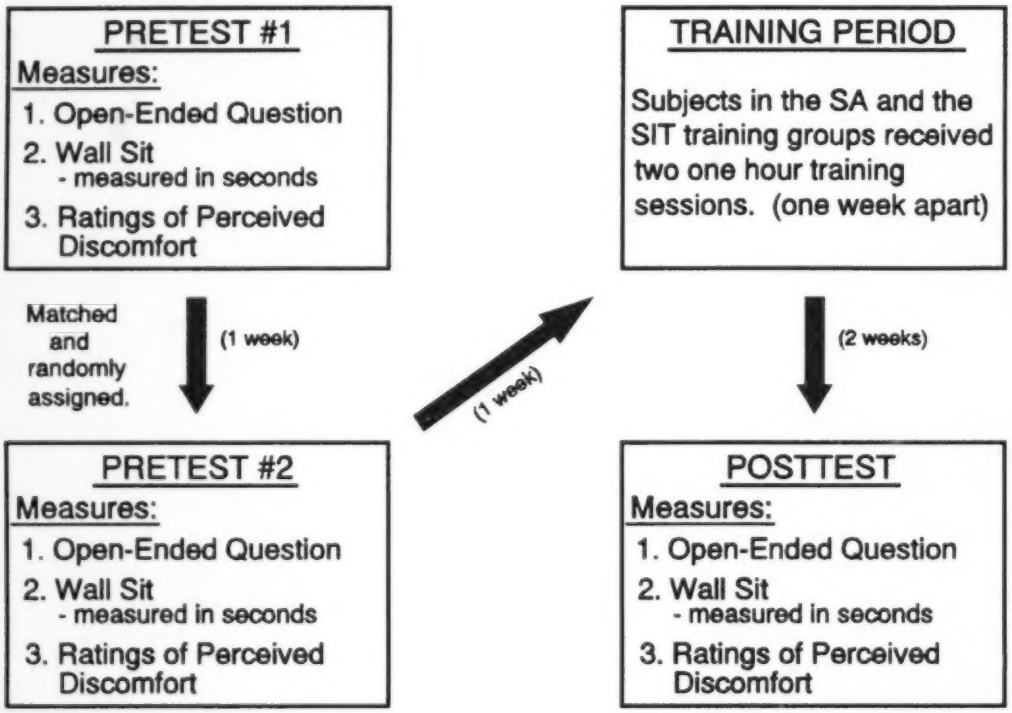
Rating of Perceived Discomfort Scale



Open-Ended Question

In the space provided below, describe how you coped with the discomfort.

Methods and Procedures



APPENDIX C

THE SKILLS ACQUISITION AND STRESS INOCULATION TRAINING PROGRAMS

Training Sessions

Control	SA	SIT
- Did not receive any psychological training - Contacted by phone to encourage subject practice and maintain motivation.	- Received two 1 hour training sessions - Acquired coping skills in 3 areas: 1. Relaxation Training 2. Attention Diversion 3. Self-Instructional Training	- Received two 1 hour training sessions - Received knowledge and training in 3 phases: 1. Conceptualization 2. Skills Acquisition 3. Application

TIMETABLE FOR SKILLS ACQUISITION GROUP

Session 1

40 minutes **Relaxation and Controlled Breathing**
- *progressive relaxation and Neideffer's "centering".*

20 minutes **Attention Diversion Strategies**
- *imagery, external diversion and internal diversion.*

Session 2

20 minutes **Attention Diversion Strategies**
- *imagery, external diversion and internal diversion.*

40 minutes **Self-Talk Strategies**
- *strategies to deal with the four stages of pain.*

Timetable for Stress Inoculation Training Group

Session 1

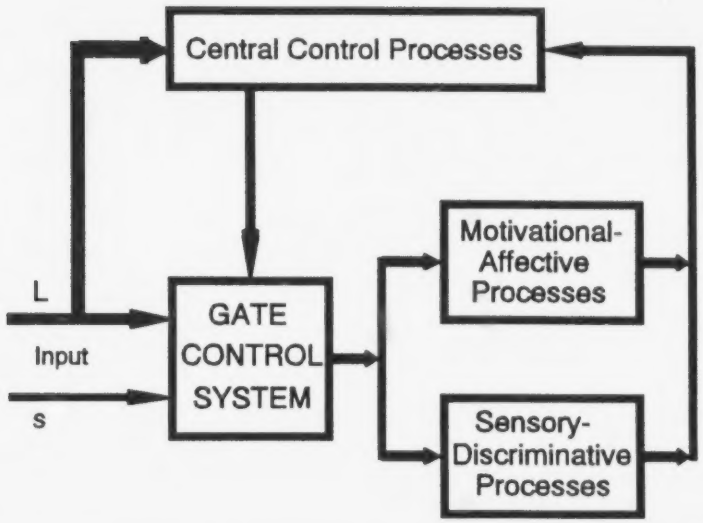
30 minutes **Education**
- *Melzack and Wall's (1965) gate-control theory.*
- *Pain as a four stage process.*

30 minutes **Skills Acquisition**
- *relaxation and controlled breathing, cognitive coping skills, and self-instruction training.*

Session 2

30 minutes **Skills Acquisition**
- *relaxation and controlled breathing, cognitive coping skills, and self-instruction training.*

30 minutes **Application**
- *opportunity to practice the newly acquired skills through in vitro and in vivo sessions.*



Conceptual model of the sensory, motivational and central determinants of pain.
(modified from Melzack and Wall, 1968)

1. SENSORY-DISCRIMINATIVE SYSTEM:

- carries information such as the location and intensity of the stimulation. Psychologically controlled through relaxation training.

2. MOTIVATIONAL-AFFECTIVE SYSTEM:

- carries information about the aversive qualities of the stimulation or suffering. Psychologically controlled through distraction and imagery training.

3. CENTRAL CONTROL PROCESSES:

- cognitive-evaluative system can close or open the gate. S fibers open the gate, L fibers close the gate. Cognitive processes affect the L fibers which may close the gate and reduce the pain. Psychologically controlled through self-instructional strategies as well as relaxation and imagery.

THE RELAXATION RESPONSE

Refers to the inborn capacity of the body to enter a special state characterized by lowered heart rate, decreased rate of breathing, lowered blood pressure, slower brain waves, and an overall reduction of the speed of metabolism. In addition, the changes produced by this Response counteract the harmful effects and uncomfortable feelings of stress.

Medical and psychological research has shown that those who develop and regularly use the Relaxation Response effectively can:

- **Relieve headaches**
- **Reduce angina pectoris pains and perhaps eliminate the need for bypass surgery**
- **Reduce blood pressure and help control hypertension**
- **Enhance creativity, especially when experiencing a "mental block"**
- **Overcome insomnia**
- **Prevent hyperventilation attacks**
- **Help alleviate backaches**
- **Enhance the therapy of cancer**
- **Control panic attacks**
- **Lower cholesterol levels**
- **Alleviate the symptoms of anxiety that include nausea, vomiting, diarrhea, constipation, short temper, and inability to get along with others.**
- **Reduce overall stress and achieve greater inner peace and emotional balance**

THE RELAXATION RESPONSE

THE FOUR BASIC ELEMENTS

1. A QUIET ENVIROMENT

- One must "turn off" not only internal stimuli but also external distractions.

2. AN OBJECT TO DWELL ON

- This object may be a word or sound repetition; gazing at a symbol or concentrating on a particular feeling. When distracting thoughts do occur, one can return to this repetition of the syllable to help eliminate other thoughts.

3. A PASSIVE ATTITUDE

- It is an emptying of all thoughts and distractions from one's mind. *A passive attitude appears to be the most essential factor in eliciting the Relaxation Response.* A person should not be concerned with how well he or she is doing.

4. A COMFORTABLE POSITION

- One should be in a comfortable posture that will allow an individual to remain in the same position for at least twenty minutes. Usually a sitting position is recommended.

HOW TO ELICIT THE RELAXATION RESPONSE

STEP ONE: Pick a brief phrase or word that reflects your personality or sport.

Since a most crucial part of any Relaxation Response technique is to use a word or phrase to meditate on, it is important to pick a word that has a special meaning to you. If the word or phrase is special to you then it is more likely that you will get more deeply involved in the Relaxation Response technique. You will look forward to practicing it , and you will do it more consistently.

It is important to take a few things into consideration when choosing an appropriate word or phrase. First, the word or phrase must be easy to pronounce and remember. Second, the words should be short enough to say silently as you exhale a breath. Examples of some words may include: one, out, strength, easy etc.

STEP TWO: Choose a comfortable position.

The position must be comfortable enough that it can be maintained for relatively long periods of time, but uncomfortable enough so that the practitioner won't fall asleep.

STEP THREE: Close your eyes.

Avoid squinting or squeezing your eyes. Close them easily and naturally. The act should be effortless.

STEP FOUR: Relax your muscles.

Starting with your feet and progressing up to your calves, thighs, and abdomen, relax the various muscle groups in your body.

Loosen up your head, neck, and shoulders by gently rolling your head around and shrugging your shoulders slightly. As for your arms and hands, stretch and then relax them, and then let them drape naturally into your lap. Avoid grasping your knees or legs or holding your hands tightly together.

STEP FIVE: Become aware of your breathing, and start using your focus word or phrase.

Breathe slowly and naturally, without forcing your rhythm. At this point, start repeating silently the word or phrase you have chosen as your mental device on each outbreath. For example, if you use the word *strength*, slowly breathe in and then out. As your breath is going out, say *strength* silently to yourself.

If you have been unable to find a mental device to repeat, you can elicit the Relaxation Response without saying any words to yourself at all. Instead, as you breathe in, focus your awareness on the expansion of your abdomen, and then on its contraction as you exhale. Visualize your abdomen as if it were a balloon that slowly fills and then slowly empties.

Remember, though, that the more you tailor the relaxation technique to your own personality or sport, the more likely it is that you will continue to use it regularly and get the full benefits of the Relaxation Response.

STEP SIX: Maintain a passive attitude.

Along with the repeated word or phrase, a passive attitude is the other most crucial aspect of eliciting the Relaxation Response. As you sit quietly, repeating your personal word or phrase, thoughts will inevitably begin to bombard your mind. You may even see mental

images or patterns that distract you from you chosen word or phrase.

But remember: They don't matter. These lapses are natural and they happen to everyone who practices the Relaxation Response technique. The key to dealing with these interruptions is learning to respond to them in a casual, unconcerned way. Do not try to force or concentrate them out of your mind.

If distracting thoughts come into your mind, simply adopt a passive attitude. In other words, do not fight the distraction. When you become aware of it, simply say to yourself, " Oh, well," and slip gently back into the repetition of your word or phrase. Even if the distracting thoughts occur the entire time you are meditating, that's all right. They are natural.

In the same way, if you are distracted by an itch or tight clothing, go ahead and scratch or rearrange your clothes so that you are more comfortable as you continue with our chosen focus words. Through regular practice, you can learn to disregard the aggressive, unsettling thoughts that push their way into your consciousness - including the bothersome thoughts about how well you are practicing the technique and whether it is working.

STEP SEVEN: Continue for a set period of time.

Practice the technique for only ten to twenty minutes. But don't time your session with an alarm or kitchen timer. This would startle you or make you anticipate the sound. Instead keep a watch or clock in plain sight, and sneak a peek now and then when you think about the time. If ten to twenty minutes have not passed, close your eyes again and return to the repetition until the full time has elapsed.

Once the session is over, sit quietly but keep your eyes closed for a full minute or two. Stop repeating the word or phrase you have been using. Allow regular thoughts to enter your consciousness once again. Finally, open your eyes slowly and sit quietly for another full minute or two. If you stand up immediately you may feel dizzy. The dizziness is not dangerous, but there is no need to experience it. As you elicit the Relaxation Response by slowly going into it, so should

you return to your everyday state in a slow, gradual manner.

STEP EIGHT: Practice the technique twice daily.

Just as it takes much practice to develop physical skills it also takes practice to effectively elicit the Relaxation Response. You should use the method twice a day. Most people do so before breakfast and before dinner. The exact time that you schedule you sessions is up to you, but the method seems to work best on an empty stomach.

THE RELAXATION RESPONSE AND SPORT

Some sports fit well with the Relaxation Response techniques, especially the aerobic activities like running, rowing, swimming and cycling. The athletic endeavors involve a rhythmic, smooth, repetitive kind of exercise that can enhance rather than detract from you ability to achieve a focused, passive frame of mind. Here's how the Relaxation Response works in common aerobic activities.

WALKING OR RUNNING

1. Get into sufficiently good condition so that you can run or walk without becoming excessively short of breath or without suffering muscle fatigue for at least thirty minutes of endurance activity. If you try to elicit the Relaxation Response when you first start your exercise program, much of your attention will be directed to how out of condition you feel.

2. Do your usual warm-up exercises before you run or walk.

3. As you run or walk, keep your eyes open. Although the standard Relaxation Response technique requires you to shut your eyes to avoid distractions, you have to see where you are going when you are combining this type of technique with exercise.

4. Become aware of your breathing. After you fall into a regular pattern of breathing, focus your attention on the in-and-out rhythm of your breath. As you breathe, say to yourself silently, "in". When you exhale, think, "out". In effect, this becomes your mental device or focus word in the same way that you use your personal phrase with the standard Relaxation Response technique. If this rhythm is uncomfortable for you - for instance, if your breathing is too fast or too slow - you can focus on something else. For example, you can become aware of your feet hitting the

ground. That is, you could silently alternate saying, "One...two...one...two."

5. Maintain a passive attitude. Just as you do with the standard Relaxation Response techniques, gently disregard disruptive thoughts. Simply think to yourself, " Oh well," and slip back into your repetitive focus word.

6. When you complete your set amount of exercise, return to your normal after-exercise routine.

OTHER ENDURANCE ACTIVITIES:

These walking or running instructions can be adapted to many different aerobic activites such as swimming, cycling and rowing. Just be sure to pick an appropriate focus word that can be fit perfectly into the physical rhythm you have established.

COGNITIVE COPING SKILLS

1. IMAGINATIVE INATTENTION

-ignoring the discomfort by engaging in imagery which is incompatible with the discomfort experience. ie. going to the beach.

2. ATTENTION DIVERSION (external)

-focussing attention on physical characteristics of the environment. ie. looking at clouds or counting telephone poles.

3. ATTENTION DIVERSION (internal)

-focussing attention on self-generated thoughts. ie. doing mental arithmetic, making lists of favorite songs or mentally building a house from scratch.

4. ASSOCIATION

-focussing on internal physiological characteristics such as heart and breathing rates while reminding oneself to "stay cool" and "relax".

FOUR STAGES OF PHYSICAL DISCOMFORT

1. Preparing for the discomfort.

2. Confronting the discomfort.

3. Coping with critical moments.

4. Reinforcing\reflecting on succesful performances

SELF-INSTRUCTIONAL TRAINING

PREPARATION

1. Reject a helpless attitude. Work at coping: develop a plan.

For example:

* **I can deal with this task. Let me actively prepare.**
* **I must just think about what I can do to deal with this. Think about a plan for future events.**

Add here any others that you can think or that will help you to begin using coping techniques when you need them.

_____

_____

_____

2. Keep a positive attitude: Stop negative thoughts and redirect your attention to positive ideas.

Some self-statements you could use:

* **Stop worrying. Worrying won't help anything.**
* **What are some of the things I can do instead?**
* **I am feeling anxious - that's natural. But that's no reason to give up. Let me just breathe deeply and relax.**

Add examples here:

_____

_____

_____

CONFRONTATION

1. Make use of the general coping strategies. Switch strategies as necessary, and use self-statements to direct your attention to as many or as few coping strategies as you need.

*** All right, I'm feeling discomfort. That lets me know that I should take some slow, deep breaths as I relax more, and switch from the strategy I was using to another one.**
*** STOP these negative thoughts. Let me just concentrate on one of the strategies to do something positive.**

Add examples here:

_____

_____

_____

2. RIMA: Relaxation, Imagery, Mental Activity. Remind yourself of the possibilities in coping techniques.

*** This discomfort is getting to me. Wait! Remember RIMA: Relaxation, Imagery, and Mental Activity. OK; let me Relax and develop a good Image (or Mental Activity).**
*** Relax. Just breathe deeply and relax.**

*** Concentrate *fully* on breathing and relaxation.**
*** I won't think about my discomfort. I will focus my attention on remembering details of the movie I saw last night.**

Take a few minutes here to review some of the strategies that were covered here in both sessions. Then add here any other self-statements that you might use to call these to mind. Develop your own versions of images, relaxation, mental activities, and so on.
Add examples here:

_____

_____

_____

CRITICAL MOMENTS

1. Be realistic in expecting some intense stimulation, but don't simply magnify the sensations. Just keep them manageable.

*** When I feel a lot of discomfort, I should just pause and them focus again on a strategy for dealing with it.**
*** I won't attempt to eliminate the discomfort totally. I just need to keep it manageable.**
*** I knew the sensations would rise. But I can keep them under control.**

Add examples here:

_____

_____

_____

2. *When you find yourself giving way to unpleasant thoughts or feelings, deliberately STOP them. Substitute coping self-statements to get you back on the right track.*

The following are some statements to use in this regard:

- *** Things are going pretty badly. I can't take any more - no wait - just pause. I shouldn't make things worse. I'll review my planned strategies to see what I can switch to.**
- *** My discomfort feels terrible. Things are falling apart. No, I'll stop that. Relax. I will focus my attention on something else. That's better, I'm regaining control. Just a slow deep breath ... Good.**
- *** I can't get my mind off the discomfort. I'll have to stop. NO! Wait a minute! I planned for this. Stop the negative thoughts. Let me use a strategy, and I'll get over this difficult time. OK, let me relax, relax, breathe slowly and deeply.**

Add examples here:

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REFLECTION

1. *At first you may notice only a little change, but note how you are beginning to gain control. You deserve a pat on the back from yourself for having tried. If you've brought the discomfort under control even a very little bit, you deserve to feel proud.*

For example:

- *** I knew I could handle it! I'm doing pretty well.**

* **I did it! I know how I will control my discomfort the next time it happens.**

Add examples here:

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ONCE AGAIN, REMEMBER THAT THE KEY IS TO *RECOGNIZE* NEGATIVE THOUGHT AND FEELINGS, TO *INTERRUPT* THEM WITH POSITIVE SELF-STATEMENTS, AND TO USE THESE COPING SELF-STATEMENTS TO GUIDE YOU IN THE USE OF *COPING STRATEGIES.*